TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Okanagan Timber Supply Area Analysis Report

July 2000

BRITISH COLUMBIA

Ministry of Forests

Okanagan Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and socio-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia. A review of each TSA and TFL is completed at least once every five years.

To determine allowable timber harvesting levels accurately and rationally, the Chief Forester must have an up-to-date assessment of the timber supply based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the TSA including guidelines for the protection of forest resources, the *Forest Practices Code* (FPC) and official land-use decisions made by Cabinet.

Assessing the implications of only current practices rather than looking at a number of different management regimes expedites the analysis process, allowing analysis of all TSAs in the province every five years. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply provide a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC), the Chief Forester considers short- and long-term implications of alternative harvest levels, the capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the Chief Forester with some of the additional information necessary for these considerations.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Okanagan Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long- (next 250 years) term. It also examines the potential changes in timber supply resulting from uncertainties associated with forest growth and forest management activities. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Okanagan TSA covers about 2 246 000 hectares in the south central interior of British Columbia. Within this area, 1 441 931 hectares are productive forest and 1 057 800 hectares are currently considered available for timber production and harvesting. Within the area available for timber harvesting, most of the forests are dominated by lodgepole pine, Douglas-fir, spruce and balsam (true firs) stands. Smaller areas are dominated by western redcedar, hemlock and deciduous species. Lodgepole pine, spruce, and Douglas-fir are the tree species most commonly identified for harvesting under current forest development plans.

The AAC for the Okanagan TSA is currently 2 615 000 cubic metres. Based on current management assumptions, the analysis shows that the current AAC may be maintained for the next 140 years and then at a level of 2 260 000 cubic metres per year in the long term.

The analyses showed that the most significant factors contributing to the projected timber supply are:

- Significant changes in forest management practices have occurred since the last analysis. These changes include the implementation of the *Forest Practices Code* (FPC) and the *Operational Planning Regulation* (OPR 107/98) provisions for ungulate winter range management; and revised criteria for estimating minimum harvestable ages;
- The relative abundance of existing merchantable stands on the TSA permits a gradual transition in the harvest from existing stands to managed stands. This transition is forecast to occur beginning in decade eight with conversion to managed stands complete by decade 15 of the planning horizon.
- The harvest forecast depicted in the base case is relatively insensitive in the short term to uncertainties in data and management assumptions. There is a long transition period during which harvesting is projected to shift from existing to managed stands. This long transition affords considerable flexibility in timber supply throughout the planning horizon.
- In the base case, it was assumed that selection silvicultural systems were employed in the selection zone and a clearcut silvicultural system was employed across the remainder of the Okanagan TSA.

Evidence from the provincial *Old Growth Site Index* (OGSI) project suggests that the estimated future productivity of sites currently occupied by old-growth stands has been underestimated. However, there is no evidence to suggest that the productivity of existing stands less than 41 years of age that make up approximately 21% of the forest stands on the timber harvesting land base in the Okanagan TSA, has been underestimated. Results of sensitivity analyses assessing the potential impacts of OGSI adjustments showed an increase in the long-term timber supply compared to the base case forecast. This result should be viewed only as a general indication of trends, since the OGSI adjustments used in the analysis were not calibrated for the Okanagan TSA.

This analysis indicates that, based on current inventory and growth and yield information and current management practices, the current rate of harvest in the Okanagan TSA can be maintained in the short- and medium-terms. Analysis of several sources of uncertainty, including the implications of forest cover retention in visually sensitive areas and minimum harvestable ages suggests that the Okanagan TSA exhibits a stable long-term timber supply. The analysis showed that short-term timber supply was not impacted by all sources of uncertainty examined in the analysis. Any changes to management practices, or data that increase managed stand yield estimates or verify the applicability of site index adjustments to the Okanagan TSA, may significantly increase timber supply across the planning horizon.

Executive Summary

The socio-economic analysis for the Okanagan TSA indicates that the current AAC of 2 615 000 cubic metres can support a provincial total of approximately 3,276 person-years of direct employment. Residents of the Okanagan TSA account for approximately 89% of this direct employment. Total provincial direct employment associated with the Okanagan TSA forestry sector supports a further 3,978 person-years of indirect and induced employment across the province.

The base case harvest forecast indicates a stable timber supply. If harvests remain at the current level, they will provide stability for employment within the Okanagan TSA and help to maintain processing activity in the south-central portion of the province.

Provincial government revenues associated with the current AAC average approximately $103.2 million per year, and could remain at this level with the continuation of current stumpage and tax rates.

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Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that influence tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect the growth and development of another part of the forest resource, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood. Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the Chief Forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units through British Columbia be reviewed at least every five years. This allows close monitoring of the timber supply and of the implications for the AAC resulting from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C. Forest Service forest inventory* plays a major role in this step. The second step is using this data along with a computer model or models to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Okanagan TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions for the timber supply analysis. Section 7 shows results of a socio-economic analysis for the Okanagan TSA. Appendixes A and B contain further details about the data and assumptions used in the analysis.

As part of the timber supply review, information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis provides information for the Chief Forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Okanagan TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry, and by assessing employment and income implications of timber harvesting level projected in the base case.

The socio-economic analysis includes an estimate of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and other woodlands related activities, processing, and silviculture. Employment is measured in terms of person-years*. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels, and fibre flows were obtained by surveying licensees and mill operators. The information was used to estimate direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment* figures were calculated using the Okanagan TSA and provincial employment multipliers* developed by the Ministry of Finance and Corporate Relations. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients* per 1000 cubic metres were also determined for the indirect and induced impacts.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Person-year(s))
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Introduction

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as general indicators.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

1 Description of the Okanagan Timber Supply Area

The Okanagan TSA, located in south-central British Columbia, covers approximately 2.25 million hectares of the Kamloops Forest Region. The TSA is one of the larger and more ecologically complex in the province, covering three forest districts. It is administered by the Forest Service offices located in Salmon Arm, Vernon and Penticton.

The Okanagan TSA is approximately 320 kilometres long and 140 kilometres wide, and stretches from the Seymour River/Shuswap Lake in the north to the Canada/U.S. border in the south, and from the Monashee Mountains in the east to the Okanagan Mountains in the west. The interaction of climate and terrain in this TSA produces a wide range of vegetation, from wet interior hemlock and cedar forests in the north to semi-arid sagebrush grasslands in the south.

The forests of the Okanagan TSA are very diverse. Within the land base currently considered available for timber harvesting, lodgepole pine and Douglas-fir are the dominant species. Subalpine fir, western redcedar and western hemlock are also common, while white pine, aspen, birch and cottonwood occur in smaller amounts. Mature and old forests predominate in this TSA, particularly at higher elevations.

About 64% of the TSA land base is considered productive forest land (approximately 1.4 million hectares). Currently about 73% of that productive forest is considered available for timber harvesting, representing about 47% of the total TSA land base.

The current AAC of the Okanagan TSA is 2 615 000 cubic metres. This level was set by the chief forester in January 1996, and was unchanged from the previous determination.

Significant changes in forest management have occurred since the last timber supply review was completed, such as:

- implementation of the *Forest Practices Code**;
- implementation of the *Operational Planning Regulation* provisions for ungulate winter range management; and,
- new criteria for defining minimum harvestable ages.

The Okanagan TSA is one of the fastest-growing regions of the province. According to the 1996 census, the population of the TSA increased by almost 20% from 1991. Almost one-half of the population lives in the three largest centres of Kelowna, Vernon and Penticton. Individuals, families, retirees and businesses from across Canada and abroad are drawn to the area because of the favourable climate, scenery, and all-season outdoor recreation opportunities and amenities.

Many Okanagan residents and tourists have lifestyles based on the pursuit of outdoor recreation activities either in, or immediately adjacent to the TSA. Public and private facilities and services are often filled to capacity and dispersed recreational use of public land is noticeably increasing. The combination of interest and opportunity has resulted in a proliferation of commercial backcountry recreation businesses of all types.

Both residents and tourists enjoy outdoor recreation activities such as hiking, camping, hunting, fishing, wildlife viewing, snowmobiling, and cross-country, telemark and heli-skiing. In the last decade, outdoor adventure tourism has increased substantially and three major ski hills are marketed as destination resorts. The increase in public and commercial recreational use of provincial forest land in the TSA has resulted in an increase in resource-use conflicts, particularly near the larger urban centres.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values..

1 Description of the Okanagan Timber Supply Area

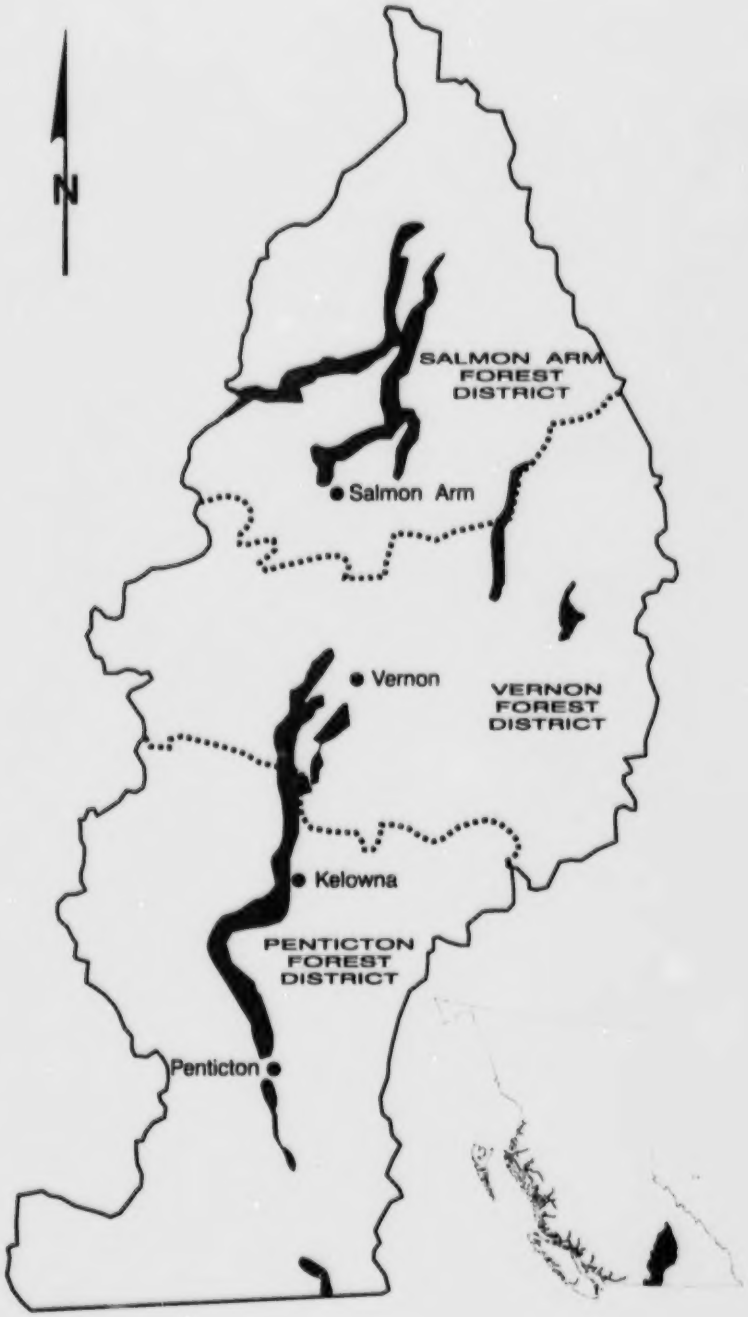


Figure 1. Map of the Okanagan Timber Supply Area, Kamloops Forest Region.

1 Description of the Okanagan Timber Supply Area

1.1 The environment

There are seven biogeoclimatic zones* in the Okanagan TSA that range from arid, hot desert in the south, to low-elevation open forests, mid-elevation forested plateaus with lakes and wetlands, and high-elevation forested areas and alpine tundra. The varied ecological features and unique nature of the area contribute to the high biodiversity* values found in this TSA.

The Bunchgrass (BG) zone comprises the grasslands that dominate the lower elevations of the Okanagan and Similkameen valleys, generally between 700 and 1000 metres. This zone is characterized by warm to hot, dry summers and moderately cold winters with relatively little snowfall. The dry climate restricts tree growth and grasslands predominate. Although not significant as a source of harvestable timber, the BG zone is very important for agriculture, tourism and biodiversity. The BG zone is one of the smallest zones in British Columbia; however it supports a wide range of wildlife, including many species that are of provincial or national significance because of their rarity or uniqueness.

The Ponderosa Pine (PP) zone occupies low elevations along the very dry valleys along the Similkameen River and Okanagan Lake, generally between 335 and 900 metres. This zone is characterized by low annual precipitation, very warm summers and cool winters. Forests of the PP zone are of limited commercial value but are used for cattle grazing particularly in early spring and late fall.

The Interior Douglas-fir (IDF) zone dominates the lower to middle elevations (350 to 1450 metres) of central and southern parts of the Okanagan TSA, and generally occurs above the BG zone and below the Montane Spruce (MS) zone. The IDF zone has warm, dry summers and cool winters, allowing a long growing season. Douglas-fir is the most common tree species, with ponderosa pine found at lower elevations, white spruce at higher elevations and lodgepole pine throughout. Forestry is a very important resource use in this zone, as is cattle grazing.

The Interior Cedar Hemlock (ICH) zone is located at lower to middle elevations (400 to 1500 metres) generally in the northeast part of the TSA above the IDF zone. The ICH zone has wet, cool winters and warm, dry summers, and is the most productive forest zone in the interior of B.C. This zone has a high diversity of tree species including western redcedar, western hemlock, grand fir, white spruce, Engelmann spruce, subalpine fir, western larch, Douglas-fir, western white pine and lodgepole pine. Forestry is a very important resource use in this zone, as is recreation.

The MS zone occurs at middle elevations (1100 to 1700 metres), generally above the IDF zone and below the Engelmann Spruce-Subalpine Fir (ESSF) zone in the south and central parts of the TSA. The climate in this zone is continental, with cold winters and moderately short, warm summers. The dominant tree species are hybrid white spruce, subalpine fir and lodgepole pine. Forestry, cattle grazing and fur trapping are important resource uses in this zone.

The ESSF zone is the uppermost forested zone in the Okanagan TSA, typically occurring at elevations between 1500 and 2300 metres (i.e., above the MS or ICH zones and below the Alpine Tundra (AT) zone). The ESSF has a relatively cold, moist and snowy continental climate. Growing seasons are cool and short, while winters are long and cold. Engelmann spruce and subalpine fir are the dominant climax tree species, while lodgepole pine is common after fires. At lower elevations, western white pine, Douglas-fir, western hemlock and western redcedar can be found. Timber and fur harvesting are important resource uses.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

The AT zone occurs at elevations greater than 2250 metres, above the ESSF zone. The climate is cold, windy and snowy with a short, cool growing season. By definition this zone is treeless and vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

The diverse forests and landscapes of the Okanagan TSA are home to a wide variety of wildlife species. The TSA also contains a number of ecosystems that are either unique to this area or of a very limited distribution provincially. The majority of species that are considered at risk or regionally significant and that occur or potentially may be found in the Okanagan TSA are presented in Table 1.

Table 1. Vulnerable, endangered and threatened species

Endangered or threatened (red-listed)		Vulnerable (blue-listed)	
white-headed woodpecker	western grebe	short-eared owl	Gopher snake (*deserticola*)
American peregrine falcon	western screech-owl ssp. *macfarlanei*	American avocet	northern bog lemming (*artemisiae*)
Brewer's sparrow (*breweri*)	northern leopard frog	American bittern	California bighorn sheep
yellow-breasted chat	tiger salamander	barn owl	cascade golden-mantled ground squirrel
burrowing owl	night snake	bobolink	fisher
ferruginous hawk	pigmy short-horned lizard	California gull	great basin pocket mouse
grasshopper sparrow	pallid bat	canyon wren	grizzly bear
lark sparrow	western red bat	flammulated owl	Nuttall's cottontail
prairie falcon	badger	long-billed curlew	spotted bat
sage grouse	white-tailed jackrabbit	great blue heron	Townsend's big-eared bat
sage thrasher	*umatilla* dace	Lewis' woodpecker	western harvest mouse
Swainson's hawk		sandhill crane	western small-footed myotis
upland sandpiper		gray flycatcher	northern long-eared myotis
		Williamson's sapsucker ssp. *thyroideus*	fringed myotis
		white-throated swift	*luscus* wolverine
		sharp-tailed grouse ssp. *columbianus*	woodland caribou (southern pop.)
		tailed frog (coastal pop.)	mountain sucker
		great basin spadefoot	bull trout
		painted turtle	chiselmouth
		rubber boa	mottled sculpin
		racer	
		western rattlesnake	

Source: B.C. Conservation Data Centre, September 1999.

Water is a primary and fundamental resource of the Okanagan TSA. Whether occurring as surface or groundwater, it is a crucial component of the ecosystems found in the TSA. As well, the rivers and lakes of the TSA are home to numerous fish species including kokanee, rainbow trout, lake char, largemouth bass and whitefish. The Shuswap Lake system supports sockeye lake spawners and provides vital rearing areas for hundreds of millions of coho, chinook and sockeye fry, making it one of the most important salmon-producing areas in B.C. The Adams River sockeye run is the second largest in the province.

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment are managed through the *Code*.

1 Description of the Okanagan Timber Supply Area

The *Okanagan/Shuswap Land and Resource Management Plan (LRMP)** process began in 1995. The planning area covers the Okanagan TSA and includes Tree Farm Licences (TFL)* 15, 33 and 49. The planning process provides an opportunity for the public, interest groups and government to make recommendations regarding new protected areas* and future management of public forest lands in the planning area. Once the management plan is completed, approved by government and implemented, it will be reflected in future timber supply reviews as current management.

1.2 First Nations

Members of eleven First Nations reside in or have traditional territories within the Okanagan TSA. Seven Okanagan bands (Lower Similkameen, Upper Similkameen, Osoyoos, Penticton, Westbank, Okanagan and Upper Nicola) are affiliated with the Okanagan Nation Alliance and two Shuswap bands (Adams Lake and Neskonlith) belong to the Shuswap Nation Tribal Council. The Little Shuswap and Spallumacheen bands are independent, but are considered part of the Shuswap Nation Community. The Upper Nicola Band is considered part of the Okanagan Nation Alliance as well as the Nicola Tribal Association.

In general, First Nations in the Okanagan TSA have expressed an interest in being involved in a full range of forestry activities including silviculture, harvesting, watershed* restoration and technical work. The Adams Lake, Neskonlith, Little Shuswap, Spallumacheen, Westbank and Osoyoos bands have woodlots within the Okanagan TSA. The Upper Similkameen band has a woodlot in the adjacent Merritt TSA. These bands, as well as the Okanagan band, have also been involved with the Small Business Forest Enterprise Program (SBFEP).

The maintenance of traditional land uses and the preservation of cultural heritage sites are also very important to First Nations. Traditional land uses are still common and include hunting, trapping, gathering berries and plants for medicine and sustenance, and use of wood materials for a variety of purposes, such as basket-making and construction. Fishery resources have a high subsistence and cultural significance to First Nations, so developments that may impact the fishery resource are of concern, as are harvesting operations in areas of cultural importance.

Archaeologists estimate that human occupation in the southern interior of the province began about 10,000 to 11,000 years ago. Archaeological studies have been completed for portions of the TSA and numerous archaeological sites have been identified. This information is considered during forest management planning and harvesting operations, and adjustments are made to protect discovered sites or resources.

Land and Resource Management Plan (LRMP)
A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.
Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

2 Information Preparation for the Timber Supply Analysis

Three categories of information are required for timber supply analysis: land base inventory; timber growth and yield; and management practices. In preparation for the analysis, a number of changes since the 1993 Okanagan TSA timber supply analysis were noted and are described in Section 2.4, "Changes since the 1993 Okanagan TSA timber supply analysis."

2.1 Land base inventory

Land base information used in this analysis came in the form of a computer file compiled in 1997 by the B.C. Forest Service. This file contains information on the forest land in the Okanagan TSA, including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical accessibility (operability*). Stand attributes such as tree height, stocking* and age have been projected to 1997. The inventory file has been updated to account for timber harvesting up to 1995 in the Penticton Forest District and up to 1996 for the Vernon and Salmon Arm Forest Districts.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development. A description of these areas specific to the Okanagan TSA is provided below. These types of areas do not contribute to the timber harvesting land base* of the Okanagan TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base. When deriving this data file, care is taken to make only a single reduction for areas which overlap (for example, where an inoperable area is also wildlife habitat).

Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Identifying areas as not contributing to timber supply does not mean the area is removed from the Okanagan TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas not contributing to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value — and sites of adequate environmental resilience — to accommodate timber harvesting with due care for other resources.

For the Okanagan TSA, the following areas were excluded from the timber harvesting land base.

- areas not managed by the B.C. Forest Service — e.g., non-Crown areas and parks. (Parks and ecological reserves contribute towards biodiversity values).
- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).
- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- inoperable areas* — areas classified as unavailable for harvest for terrain-related reasons. Characteristics used to define operability include slope, topography (e.g., presence of gullies or exposed rock), difficulty of road access, soil stability and elevation.

Timber harvesting land base
Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.
Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

- Timber Licences — Timber Licences provide the holder rights to harvest mature timber from the licence area. These areas revert to the TSA when they have been harvested and satisfactorily restocked (i.e., free-to-grow) by the licensee.
- Deciduous*-leading stands — deciduous species are generally not utilized in the Okanagan TSA.
- problem forest types — stands which are physically operable and exceed low site criteria yet are not currently utilized because of low timber quality or volume.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- existing roads, trails and landings — areas of forest land that have been removed from timber production due to previous access development and harvesting.
- environmentally sensitive areas* — portions of the areas considered sensitive.
- riparian reserve zones— areas otherwise available for timber production, a portion of which is assumed to be unavailable for harvesting to provide protection for riparian values and stream ecosystems.
- wildlife tree* patches— areas reserved within and along the edges of cutblocks* for the maintenance of stand-level biodiversity* (stand structure), primarily for conservation or enhancement of wildlife habitat.

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base.

The current timber harvesting land base in the Okanagan TSA represents 47.1% of the total TSA area and 73.4% of the productive forest. The categories which most reduce the availability of the productive forest for timber supply are: inoperable areas (8.0%), problem forest types (4.3%), environmentally sensitive areas (3.3%) and provincial parks (2.9%). The remaining deducted categories, such as riparian reserve zones, represent 8.1% of the productive forest. Because there is a high degree of overlap among land classification categories, the order in which the reductions are made essentially dictates the area value portrayed in this table. For instance, riparian reserve areas would constitute a larger proportion of the reduction if they were deducted prior to inoperable areas.

Deciduous
Deciduous trees commonly have broad-leaves and usually shed their leaves annually.
Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.

Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Cutblock
A specific area, with defined boundaries, authorized for harvest.
Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

2 Information Preparation for the Timber Supply Analysis

Table 2. Determination of the timber harvesting land base for the Okanagan TSA

Classification	Area (hectares)	Per cent of total area	Per cent of productive forest area
Total area on inventory file	2 246 713.0	100.0	
Non-Crown land	(405 579.1)	18.1	
Non-forest Crown land	(399 202.8)	17.8	
Total productive forest	**1 441 931.1**	**64.2**	**100.0**
Reductions to productive forest:			
Roads, trails and landings	21 357.8	1.0	1.5
Ecological reserves	4 277.9	0.2	0.3
Provincial parks	42 515.4	1.9	2.9
Inoperable areas	115 341.6	5.1	8.0
Low site productivity	17 432.6	0.8	1.2
Environmentally sensitive areas	47 403.3	2.1	3.3
Deciduous forest types	35 658.0	1.6	2.5
Problem forest types	62 512.3	2.8	4.3
Riparian areas*	37 677.1	1.7	2.6
Total current reductions	**(384 176.1)**	**17.1**	**26.6**
Current timber harvesting land base	**1 057 755.0**	**47.1**	**73.4**
Future additions and (reductions)			
Timber licence reversions[a]	14 602.1	0.6	1.0
Future roads, landings, trails	(41 256.3)	1.8	2.9
Long-term timber harvesting land base	**1 031 100.7**	**45.9**	**71.5**

(a) Timber licences were initially excluded from the timber harvesting land base, but were added after the areas are projected to be harvested and restocked by the licensee.

Riparian areas
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.

2 Information Preparation for the Timber Supply Analysis

Figure 2 represents both the total Okanagan TSA area, and the productive forest land base. The total TSA land base chart shows that about 18% of the total land base is not managed by the B.C. Forest Service, and 18% is classified as non-forest or non-productive forest (i.e., having very few trees). The productive forest land base chart details the categories of forest land and shows that about 27% of the forest land in the Okanagan TSA is considered to be unavailable for harvesting. The predominant reasons for unavailability are physical or economic inoperability, problem forest types, and environmental sensitivity. Approximately 73% of the productive forest is considered available for timber harvesting (including not satisfactorily restocked (NSR)* and timber licences).

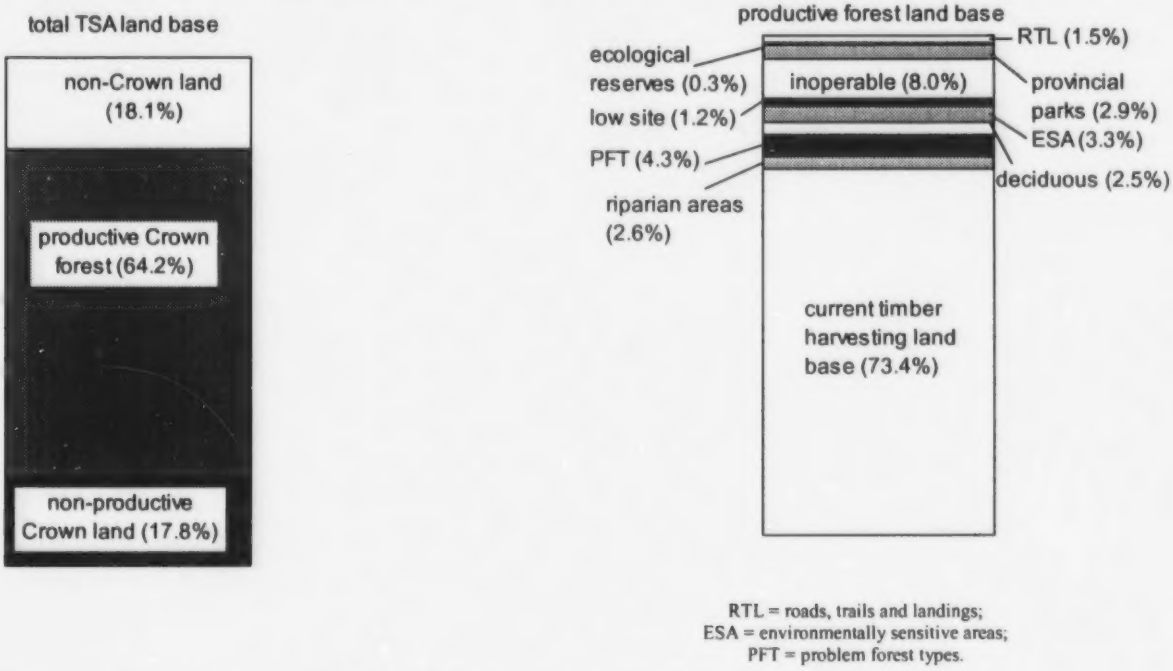


Figure 2. Composition of the total and productive forest land bases — Okanagan TSA, 2000.

Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR..

2 Information Preparation for the Timber Supply Analysis

Figure 3 shows the current composition of the timber harvesting land base by dominant tree species. Lodgepole pine dominates in stands on 34% of the area of stands within the timber harvesting land base, with Douglas-fir dominating 30%, spruce 14%, balsam 12%, cedar 6%, and hemlock 5%. After harvest, stands are expected to be regenerated to stands as described in Section A.4.7 of Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis").

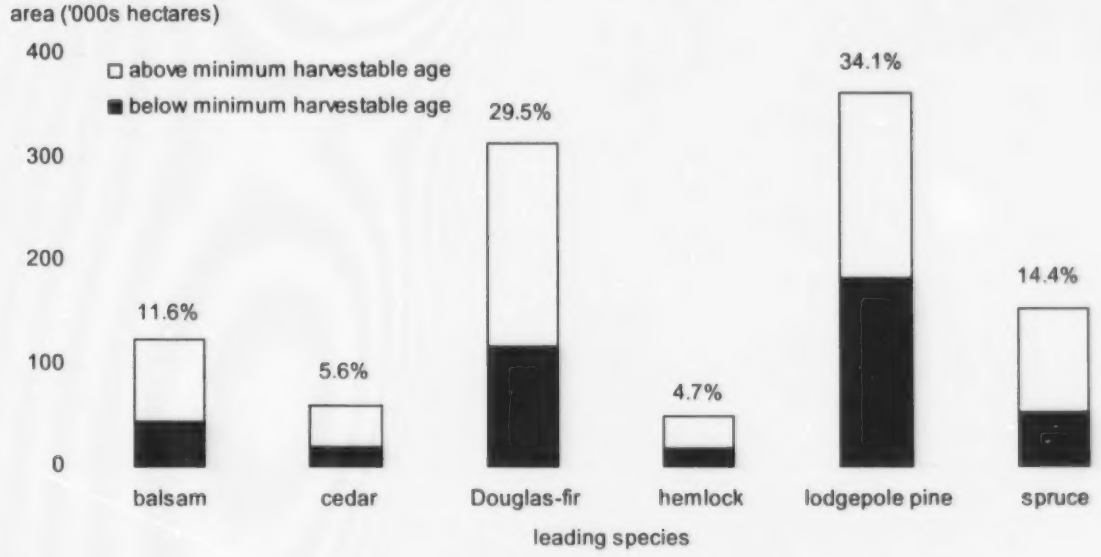


Figure 3. Area by dominant species — Okanagan TSA timber harvesting land base, 2000.

Figure 3 also shows the proportion of area covered by stands of each leading species that is either younger or older than the minimum harvestable age (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the minimum harvestable age for each species). In total, 59% of the timber harvesting land base is covered with stands at or above minimum harvestable age. There is variation around this proportion for each of the species groupings: 49% of lodgepole pine stands, 63% of Douglas-fir stands, 66% of spruce stands, 65% of balsam stands, 69% of cedar stands and 65% of the hemlock stands are currently older than the minimum harvestable age.

2 Information Preparation for the Timber Supply Analysis

Figure 4 provides an overview of the distribution of site productivity of the dominant stand types within the timber harvesting land base. The site classes found in Figure 4 are groupings of stands by site index*. Approximately 52% of the stands are classified as having a site class of 'medium' while stands with a site class value of 'good' occupy 17% of the area, and those with a site class value of 'poor', 31%. Those areas with a site class of 'low' are excluded from the timber harvesting land base.

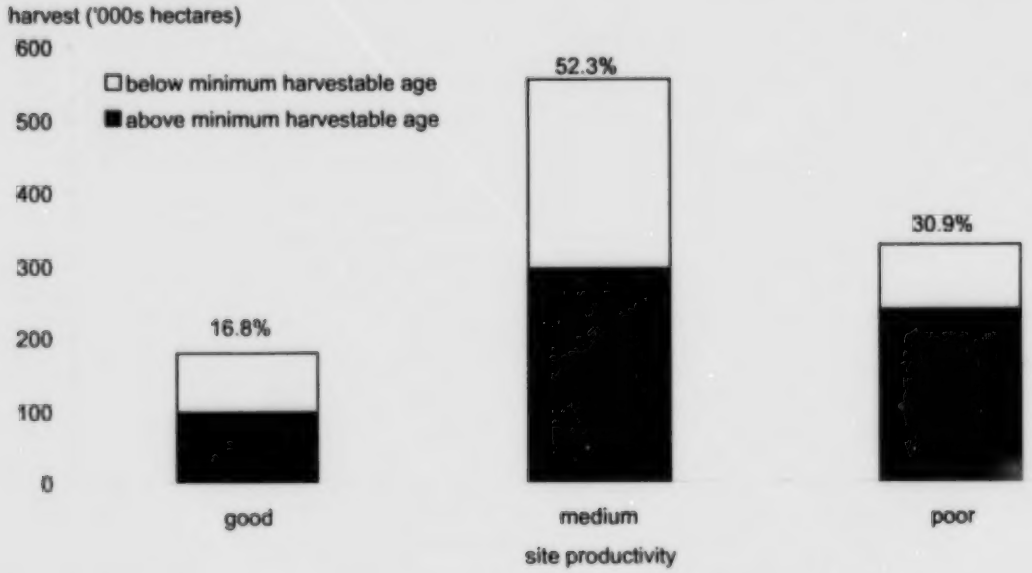


Figure 4. Area by site class — Okanagan TSA timber harvesting land base, 2000.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Figure 5 shows the current age composition of forested stands in the Okanagan TSA. Within the timber harvesting land base, 20% of the stands are older than 250 years. About 25% of stands are 20 years or younger, 31% are between 21 and 100 years old, and 24% are between 101 and 250 years of age. Approximately 59% of the stands in the timber harvesting land base are at or above the minimum harvestable age applicable to the stand.

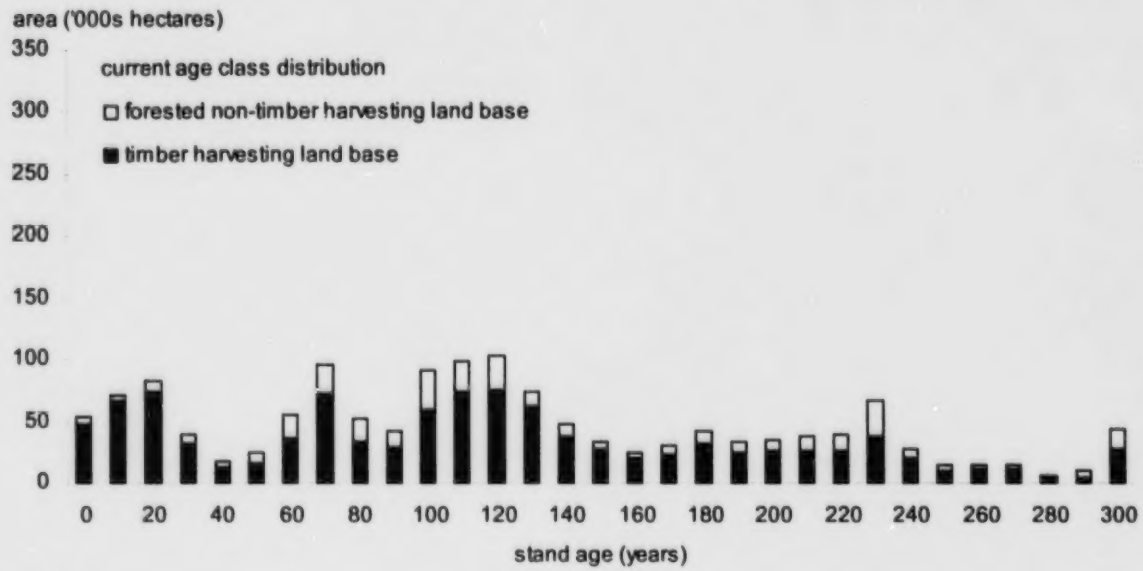


Figure 5. Current age class composition — Okanagan TSA productive forest land base, 2000.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. Within the Okanagan TSA, 26.6% of the total forested land base of 1 441 931 hectares (which includes some land not managed by the B.C. Forest Service) is unavailable for harvesting but can affect the extent and pattern of harvesting within the TSA by contributing to old-forest and biodiversity requirements. About 9.5% of stands outside of the timber harvesting land base are older than 250 years. Only 5.4% of the stands are 20 years or younger, 35.1% are between 21 and 100 years old, and 50% are between 101 and 250 years of age.

In the long term, the non-timber harvesting land base will be able to provide all but 12 517 hectares of the area needed to meet old-forest biodiversity requirements. However, some old-forest timber harvesting land base will have to be reserved from harvesting into the medium term while forests in the non-timber harvesting land base age sufficiently to achieve old-forest conditions.

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many growth and yield related characteristics that change over time (for example, number of trees per area, tree diameter, tree height, species composition). Since timber supply analysis concentrates on timber volumes available over time, the most relevant measure for this analysis is volume per area (in British Columbia, cubic metres per hectare). An estimate of timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Okanagan TSA analysis. The variable density yield prediction (VDYP) model developed by the B.C. Forest Service, Resources Inventory Branch, was used for estimating volumes of existing natural stands. The table interpolation program for stand yields (TIPSY), developed by the B.C. Forest Service, Research Branch was used to estimate volumes of coniferous* managed stands. Stands less than 21 years of age and those stands that will be established in the future were assumed to be managed.

Volume estimation and prediction are subject to uncertainty due to uncertainties in the inventory information used to estimate site productivity, the limited experience with second-growth stands in British Columbia, and the long time frame over which trees grow. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from the estimates used in this analysis.

Based on timber volume estimates*, the current timber inventory on the timber harvesting land base is approximately 221.4 million cubic metres. About 191.2 million cubic metres, or 86%, of the total, are currently merchantable; that is, older than minimum harvestable age.

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and associated regulations guide forest management practices in the Okanagan TSA. The focus of the Timber Supply Review is to assess timber supply based on current management practices as implemented in plans for the area. Current management is described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis"). Staff in the Salmon Arm, Vernon and Penticton Forest Districts provided information on the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species.
- Incremental silviculture — planting of genetically improved stock and the application of stand density management.
- Forest health and unsalvaged losses* — estimated timber losses due to fire, wind and pest damage.
- Utilization levels — minimum sizes of trees and logs to be removed during harvesting.

Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.

- Minimum harvestable ages (MHA) — an estimate of the time it takes a stand to grow to a merchantable condition. These were based on district priorities, yield tables and input from local forest industry representatives. Actual harvest age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Cutblock adjacency* and green-up* — in the Okanagan TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up (3 metres in height for integrated forest management area and 4.5 to 6.5 metres in height for visual quality management areas), before adjacent stands may be harvested. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time. These guidelines were modelled by limiting the area of the integrated resource management (IRM)* zone that does not meet green-up conditions to a maximum of 33%.
- Ungulate winter range — to provide ungulates with acceptable winter habitat, harvesting activities are modified through forest cover requirements as found in the *Okanagan Timber Supply Area Integrated Resource Management Timber Harvesting Guidelines*.
- Protection of environmentally sensitive areas where forest regeneration problems have been identified. To maintain ecological and other resource values, land has been wholly removed from the timber harvesting land base.
- Community watersheds — within designated community watersheds a maximum of 30% of the forest area may be covered by stands less than six metres in height at any given time. Community watersheds cover 19.9%, (213 348 hectares) of the timber harvesting land base.

Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives.
Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Integrated resource management
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

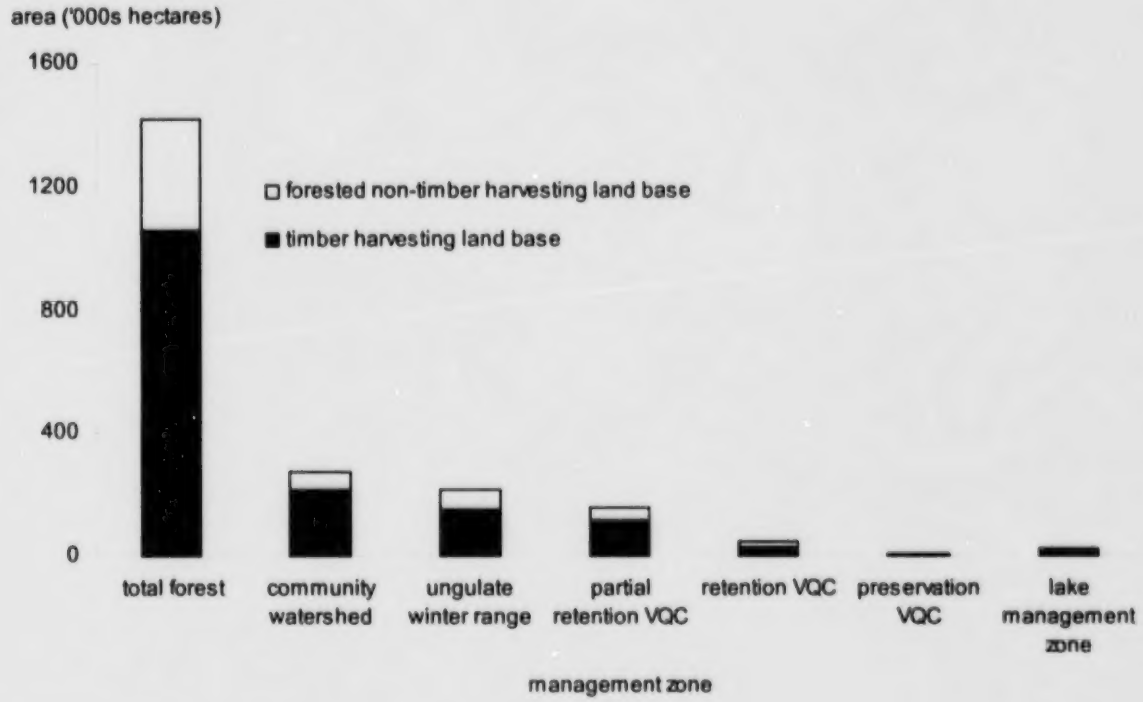
- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting must be kept within specified limits in some areas of the Okanagan TSA. The maximum proportion of each scenic area* that may be covered by young stands that do not meet green-up requirements varies depending on the forest characteristics and visual quality objectives (VQO)* and the visual absorption capability (VAC) for each area, but ranges between 3.5% and 21.3%.
- Landscape-level biodiversity* — to maintain biological diversity throughout a landscape unit*, the *Forest Practices Code* contains targets for the proportion of the area in each biogeoclimatic variant* that should be covered by stands with old-forest characteristics. Since landscape units and biodiversity emphasis options have not been established for each landscape unit, a weighted average old-seral requirement was applied to draft landscape units.
- Harvest systems — the timber harvesting land base supports clearcut and partial harvesting systems.

The data package for the Okanagan Timber Supply Area (TSA) was released in June 1999. As a result of public input, changes were made to the data package. The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Landscape-level biodiversity
The Landscape Unit Planning Guide *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*

Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Figure 6 shows the proportions of the forested land base and the timber harvesting land base subject to management for scenic values, community watershed considerations, ungulate winter range and lakeshore management designations. The proportion of each management zone within the timber harvesting land base relative to the total forested area is represented in each bar. Often several management objectives are applied to the same area; for example, all or part of a visually sensitive area may also be managed as a community watershed.



VQC = Visual Quality Class

Figure 6. Forest management zones — Okanagan TSA forested land base, 2000.

Figure 7 shows the distribution of the land base by biogeoclimatic (BEC) variant. Also shown is the proportion of the total forest area in each BEC variant that is in the timber harvesting land base. For example, the MSdm1 variant makes up 7.1% of the total forest area, while 84.9% of the total area of MSdm1 is within the timber harvesting land base.

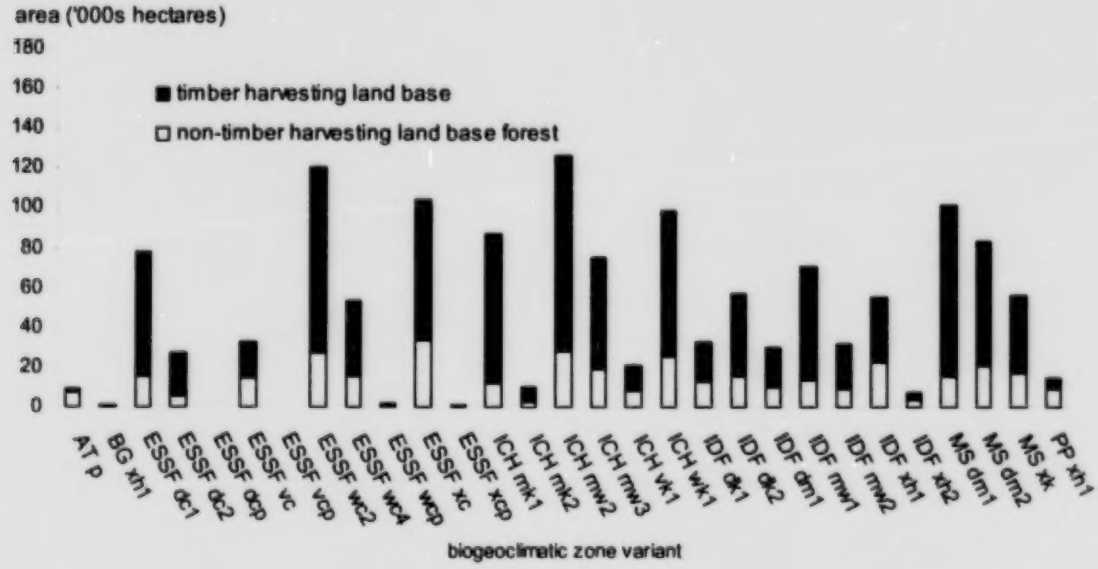


Figure 7. Area by biogeoclimatic classification — Okanagan TSA, 2000.

2.4 Changes since the 1993 Okanagan TSA analysis

The size and availability of the timber harvesting land base, management practices and modelling capabilities have changed since the last analysis for the Okanagan TSA. The objective of this section is to present the major changes to the land base and forest management assumptions since the last analysis.

- In the last analysis the productive forested area considered in the Okanagan TSA analysis was 1 403 309 hectares. It is now 1 441 931 hectares, mostly due to updated ownership information and the inclusion of parks for biodiversity considerations.
- The timber harvesting land base has increased by 3.2% since the last analysis. In the previous analysis the timber harvesting land base was 1 039 089 hectares. It is now 1 072 357 hectares. This change is mostly the result of revisions to the criteria used to define problem forest types and the approach used to account for existing roads, trails and landings.
- Implementation of the *Forest Practices Code* has increased land base reductions for riparian reserves and volume reductions for wildlife tree patches (WTPs). Requirements to maintain or recruit suitable areas of old forest for landscape-level biodiversity also limit the availability of timber for harvesting.
- The use of a computer-based geographic information system (GIS) has enabled modelling including the application of forest cover requirements at a finer level of detail than was achievable in the previous analysis.
- Deductions to account for riparian areas are now applied on an area-specific basis rather than as a general percentage area reduction.

- While the area with approved visual quality objectives (VQO) has remained the same, one of 12 distinct forest cover requirements is now applied to 2081 individual visual management polygons. In the last analysis, a single forest cover requirement was applied to a single polygon.
- Changes in the criteria used to define both minimum harvestable ages and sites with low productivity have influenced the scheduling of stands for harvest, as well as which stands are excluded from the timber harvesting land base.
- Based on new information, the estimated unsalvaged losses are 75 000 cubic metres per year compared to 126 610 cubic metres per year in the last analysis.
- An audit of hemlock and pine problem forest types provided updated inventory information for these stands. As a result, some of these stands no longer meet the problem forest type criteria and are considered available for harvesting.
- Older hemlock-leading stands which were excluded in the previous analysis are included in the timber harvesting land base based on direction from the Chief Forester in *Okanagan Timber Supply Area – Rationale for Allowable Annual Cut (AAC) determination – effective January 1, 1996.*

In summary, the timber harvesting land base has increased by 3.2% and some modelling assumptions have changed since the last analysis. Given the extent of these changes, direct comparisons between this and the previous analysis cannot be made. Each analysis should be evaluated in the context of the management regimes and related data inputs and assumptions that were applied at the time. As noted in the introductory section, there is uncertainty in the information used in timber supply analyses and forest management objectives are evolving, which is why the *Forest Act* requires the Chief Forester to periodically review the timber supply and AAC for each TSA.

Any changes to the land base or management assumptions that may occur or become effective subsequent to this timber supply analysis will be presented to the Chief Forester for consideration during the AAC determination.

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Okanagan TSA, under current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used in the assessment. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast*. The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how trees grow and area harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

4 Results

This section presents results of the timber supply analysis for the Okanagan TSA. The base case harvest forecast uses the most recent assessments of current forest management, the land available for timber harvesting, and timber yields as described in Section 2, "Information Preparation for the Timber Supply Analysis." Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Okanagan TSA, and should not be viewed in isolation of the sensitivity analyses*.

4.1 Base case harvest forecast

Figure 8 shows the base case harvest forecast for the Okanagan TSA. The initial harvest level is 2 615 000 cubic metres per year (the same as the current AAC) and the long-term harvest level* is 13.6% lower at 2 260 000 cubic metres per year. Unsalvaged losses due to natural causes such as insects, wind and fire are estimated to be 75 000 cubic metres per year for the entire 250-year horizon and have been subtracted from all harvest forecasts shown in this report.

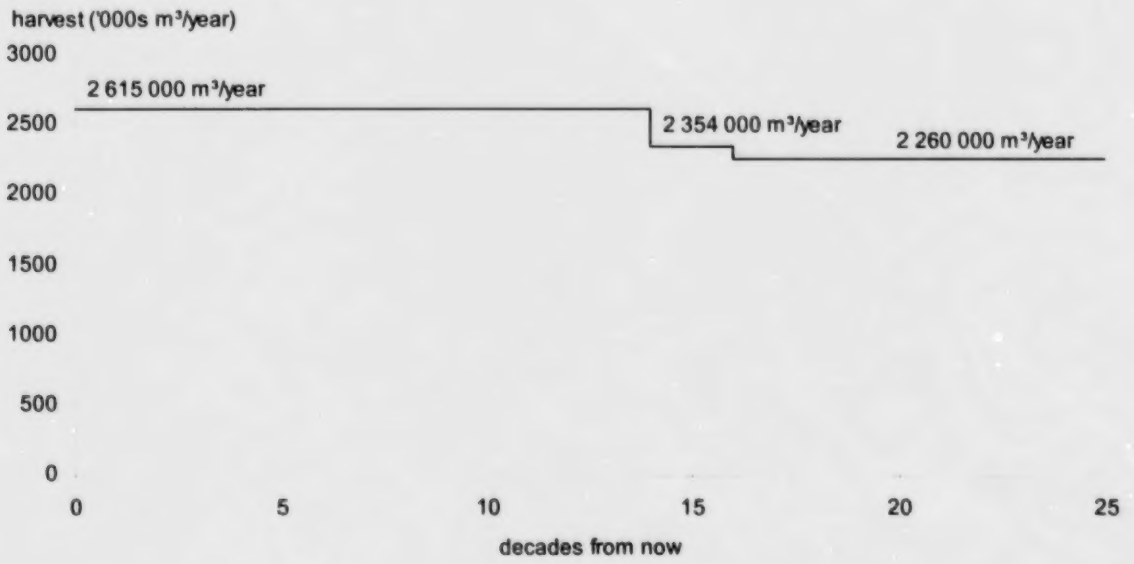


Figure 8. Base case harvest forecast for the Okanagan TSA, 2000.

Section 2.4, "Changes since the 1993 Okanagan TSA analysis," provides an overview of the major changes to the land base and management assumptions since the last analysis. The summary concludes that any comparison between this and the last analysis should be made with recognition of the extent and nature of those changes. Any analysis should be evaluated in the context of the management regime and related data inputs and assumptions that apply at the time. One of the major reasons the Chief Forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in forest management practices, as well as new information that may resolve some uncertainties.

Sensitivity analysis
A process that examines how uncertainty in data and management assumptions affect timber supply.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Prior to selecting the base case, a number of forecasts were developed to analyse the potential timber supply for the Okanagan TSA. Figure 9 presents two of these forecasts, while the following paragraphs describe how the alternative forecasts were evaluated, and how the final selection of the base case harvest forecast was made.

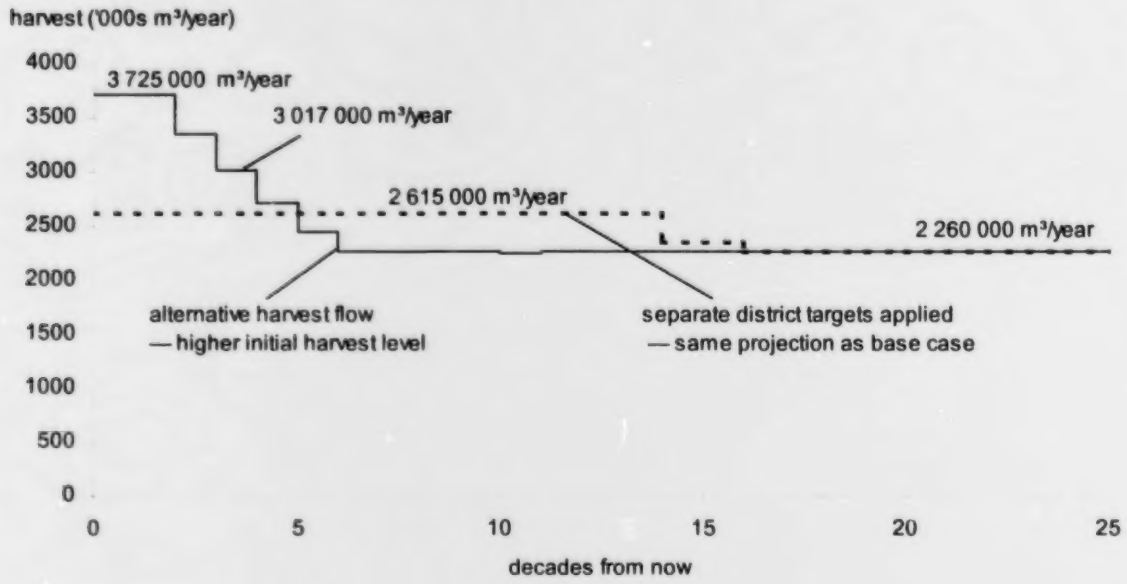


Figure 9. Alternative harvest flows — Okanagan TSA, 2000.

The first alternative harvest flow tested the feasibility of increasing the initial harvest level without compromising the medium-term or long-term harvest levels. Results show that a harvest level of 3 725 000 cubic metres per year can be maintained for two decades before declining by 10% per decade to a long-term harvest level of 2 260 000 cubic metres per year in decade 6.

The second alternative harvest flow tested the feasibility of assigning a minimum harvest level to each of the three districts within the Okanagan TSA. The assigned levels were based on historic harvest levels within each district. This was implemented as a minimum target for each district with the total adding up to 97% of the entire TSA target in order to allow for some flexibility. The targets were applied for the first five decades and were implemented as follows; Salmon Arm Forest District 26%, Vernon Forest District 37% and Penticton Forest District 33% of the total harvest level. The resulting harvest flow is the same as the base case projection; however there are differences in stand age, species composition and pattern of harvesting in the model.

Major reasons for the selection of the base case harvest forecast are:

- The harvest forecast which projected a maximum level of harvest in decade one was not selected since this is dependent on a stable timber harvesting land base. Due to the existence of the *Okanagan / Shuswap Land and Resource Management Plan* (LRMP) process and the likelihood of the creation of additional protected areas this may not be a valid assumption.
- The LRMP may also result in other management guidelines which will affect harvesting practices and the size of the timber harvesting land base.
- As the AAC is determined on a TSA basis it was decided not to use the administrative area targets.

4.1.1 Base case timber supply dynamics

Currently, 60% of the timber harvesting land base is comprised of stands with ages greater than 100 years. Figure 10 shows the transition of harvest from existing to managed stands for the base case. During the first eight decades the harvest is derived entirely from existing stands; during decades 9 through 11 the harvest shifts from existing to managed stands.

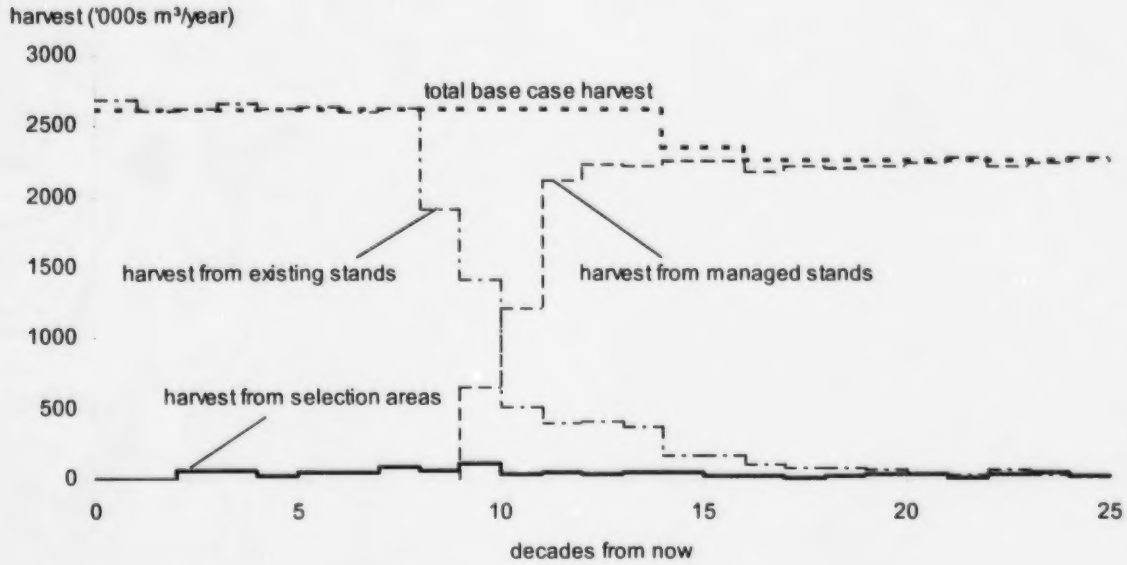


Figure 10. Harvest contribution from the existing and managed stands — Okanagan TSA, 2000.

4 Results

Figure 11 shows the transition from existing to managed stand growing stock*. Note that approximately 10 decades from now the growing stock is evenly distributed between existing stands and managed stands. After 10 decades, managed stands make up an increasingly larger proportion of the total harvest forecast.

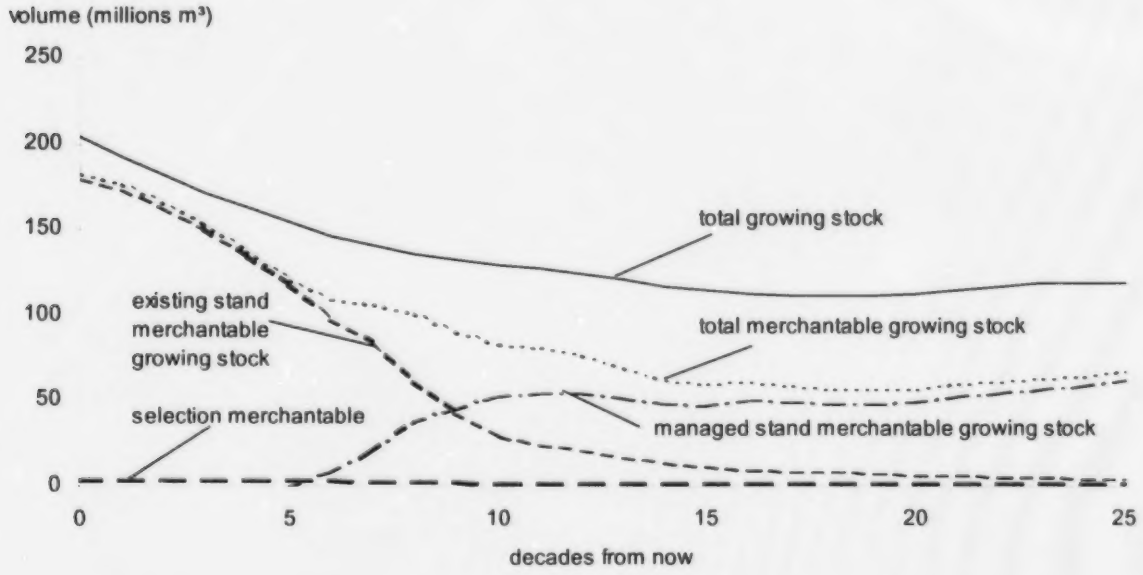


Figure 11. Total and merchantable growing stocks — Okanagan TSA, 2000.

The period during which harvesting shifts from existing to managed stands results in the following timber supply dynamics for the Okanagan TSA:

- The extensive existing growing stock provides flexibility and capacity to absorb increasing constraints on the forested land base that could reduce timber supply while enabling the base case short-term and medium-term timber supply to be achieved. For example, if managed stand yields were lower than assumed in the base case, short-term timber supply would be unaffected, because the managed-stand volumes are not harvested until well into the future. However, long-term supply would decrease compared to the base case forecast* (see Section 5.1.3, "Uncertainty in estimated managed stand yields").
- If managed stand characteristics or practices are less constraining to timber supply than assumed in the base case (e.g., less restrictive VQO requirements or lower minimum harvestable ages), then more merchantable managed stand growing stock becomes available earlier. For the Okanagan TSA, the medium- and long-term timber supply increase in such cases.

Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses" illustrate these dynamics.

Growing stock
The volume estimate for all standing timber at a particular time.

Base case forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

4.2 Area, average volume and average age harvested

Figure 12 tracks the change in the average age of stands harvested in the base case projection. Currently, 35% of the stands in the timber harvesting land base are older than 140 years of age. These stands dominate the timber supply for the first nine decades of the forecast. From decade 10 onward, managed stands comprise more of the forecast harvest, and the average age of the stands harvested — approximately 100 years — trends slightly above the area-weighted average minimum harvestable age of 93 years.

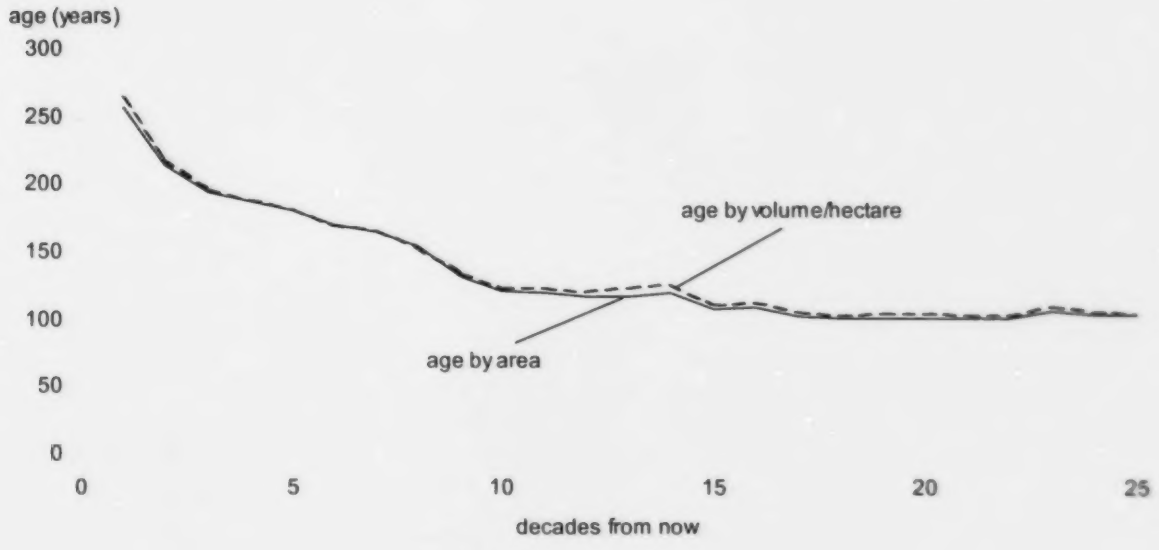


Figure 12. Average age of stands harvested over time — Okanagan TSA base case, 2000.

About 34.1% of stands within the timber harvesting land base are pine-leading and have a minimum harvestable age of 80 years. The remaining 65.9% of stands are assumed to have a minimum harvestable age of 100 years. As a result, the long-term average area-weighted minimum harvestable age of stands is 93 years.

Figure 13 shows the projected average area and volume harvested per year over the next 250 years under the base case forecast. For the first nine decades timber supply is forecast to come from high volume old-growth stands. However, over time average stand volumes are projected to decrease and the associated area harvested is forecast to increase. After decade 10, when the harvest is composed mostly of younger, lower volume second-growth stands, more area is harvested annually to maintain the base case harvest level. Fluctuations in the amount of area harvested per period after decade 10 result because stands become merchantable at different ages when stand volumes are different (lower productivity stands have lower volumes, and more area would be required to harvest the same volume than from stands of higher productivity). Timing of availability of areas subject to different forest cover requirements can also lead to fluctuations in area and volume harvested.

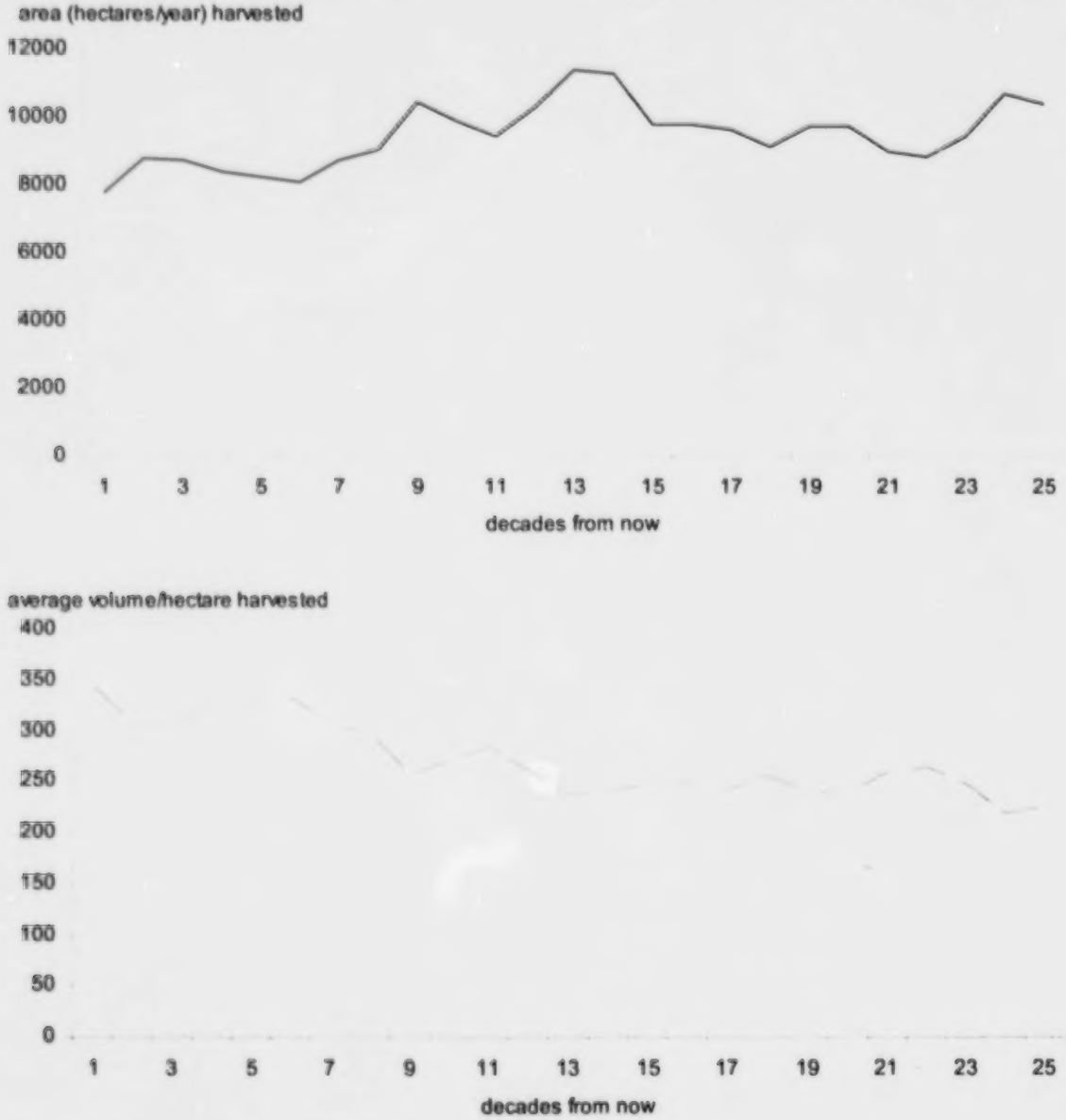


Figure 13. Average area harvested and average volume per hectare harvested over time — Okanagan TSA base case, 2000.

4.3 Age class profile over time

The charts in Figure 14 show how the age composition of the productive forest within the Okanagan TSA land base changes under the base case harvest forecast.

The current age class distribution shows a relatively high proportion of older stands within the timber harvesting land base with 35% of the timber harvesting land base still in stands over 140 years old.

Forty-two per cent of the area outside of the timber harvesting land base is covered by stands over 140 years old. Younger stands occurring on the remaining 58% of the areas outside of the timber harvesting land base exist largely because of fires, and occasionally past harvesting practices that occurred under different economic conditions or prior to the *Forest Practices Code*. For example, in the past, some harvesting occurred in riparian areas that are now deducted from the harvesting land base. Also some areas outside of the timber harvesting land base have been previously harvested in order to salvage stands damaged by pests and/or windthrow.

One consequence of the large area (365 000 hectares) of stands outside the timber harvesting land base is that a relatively small proportion of the timber harvesting land base needs to be initially reserved from harvest to meet old seral* stage landscape-level biodiversity objectives. However, even with the phase-in of old-seral stage requirements, and a good distribution of older stands within landscape units, some stands in the timber harvesting land base are permanently reserved. The charts in Figure 14 show the progression of age class distribution in 50-year intervals. Reserving of stands for long periods extends the time over which existing stands are harvested, and results in fluctuations around average volume and area harvested into the long term. Over the long term, approximately 12 500 hectares of the timber harvesting land base are permanently reserved from harvest.

Old seral
Old seral refers to forests with appropriate old forest attributes which provide for biodiversity. Ages vary depending on biogeoclimatic variant and are specified in the Landscape Unit Planning Guide.

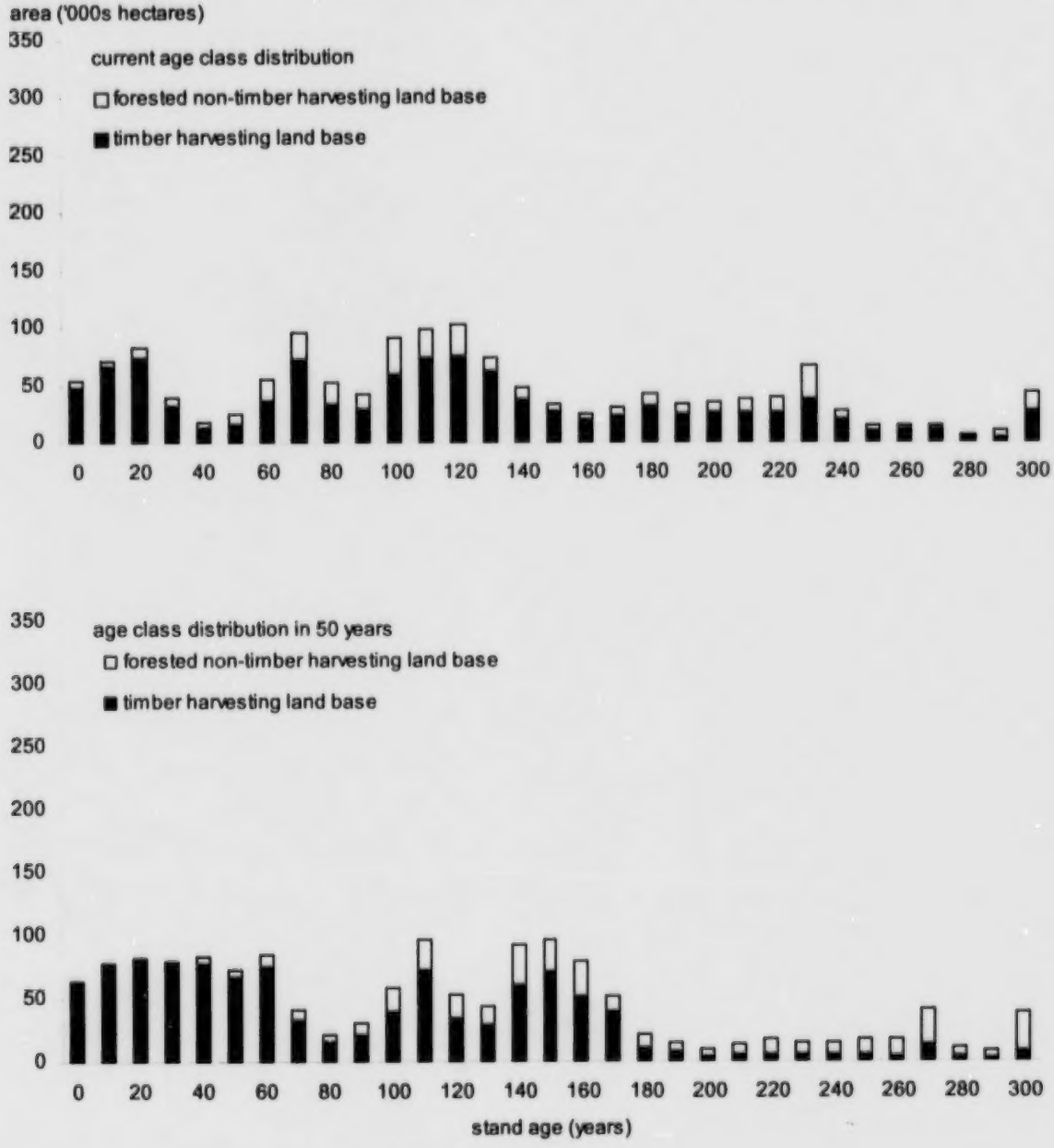


Figure 14. Changes in age composition on the productive land base over time — Okanagan TSA base case, 2000.

(continued)

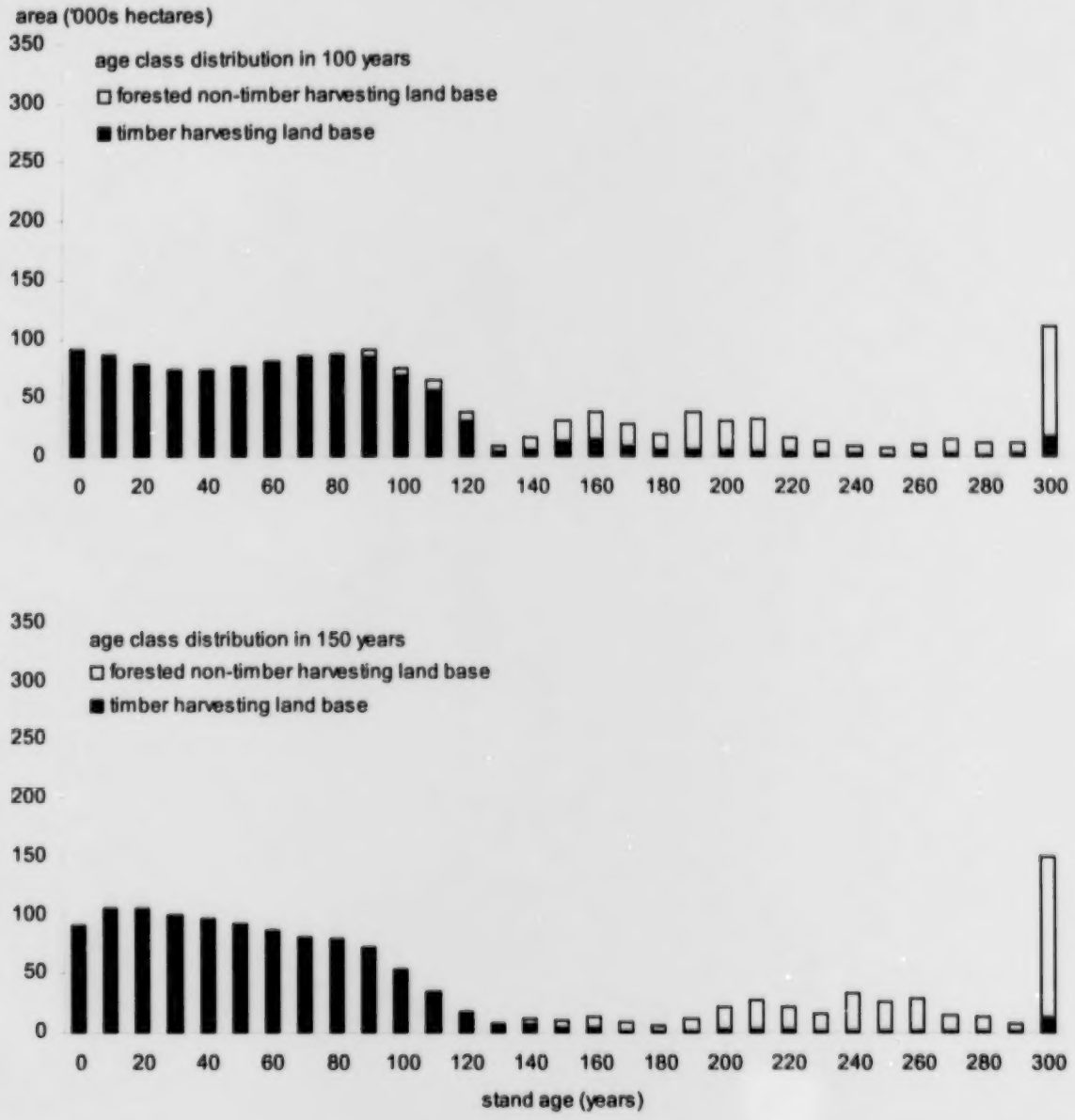


Figure 14. Changes in age composition on the productive land base over time — Okanagan TSA base case, 2000.

(continued)

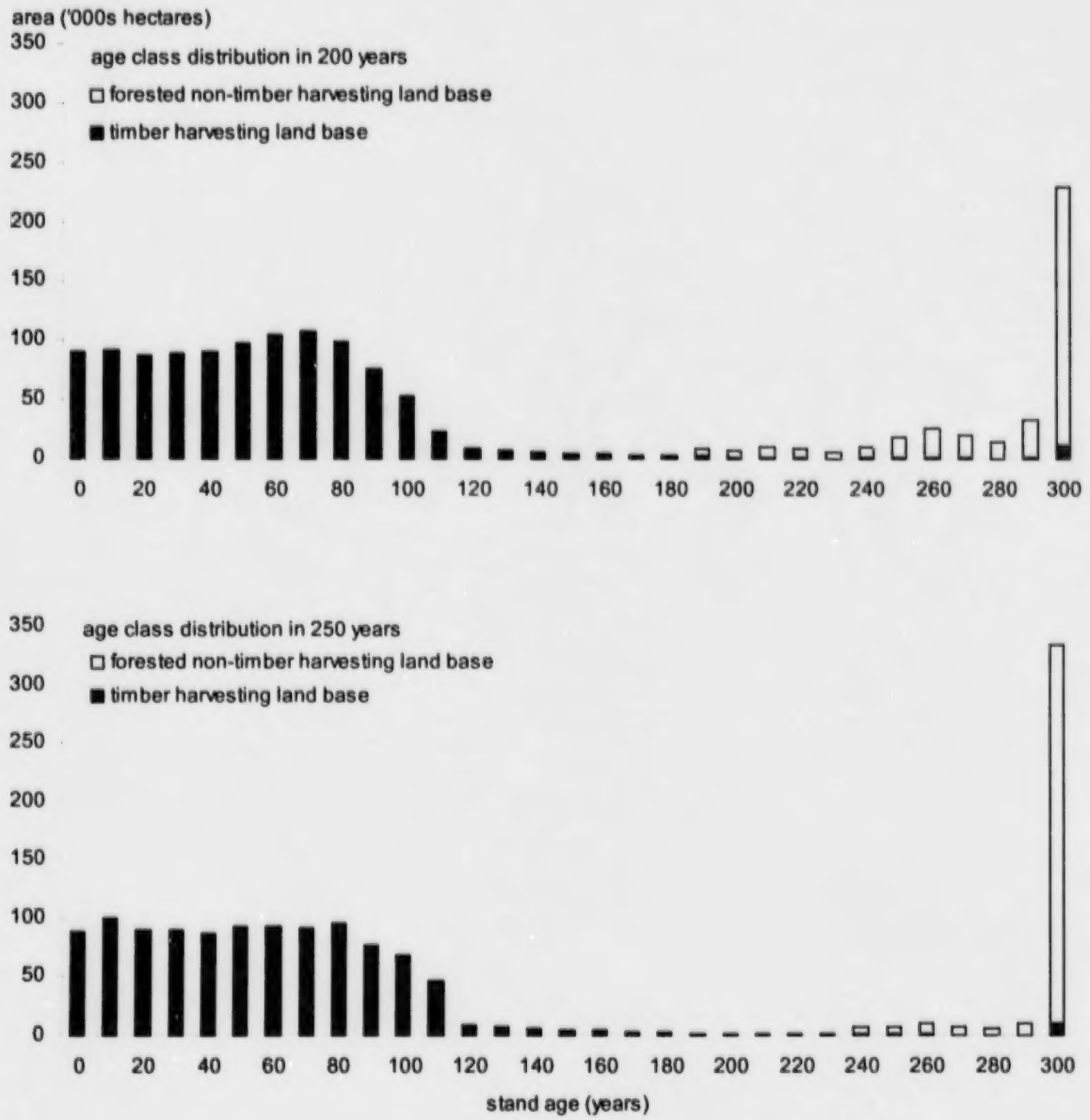


Figure 14. Changes in age composition on the productive land base over time — Okanagan TSA base case, 2000.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated and ever-changing endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all the data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to minimize uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how timber supply could change if the information used in the analysis is not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that small uncertainties about some variables could have large effects on timber supply projections, or conversely that large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide a safe basis for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of a number of sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case.

For this analysis, short-term timber supply refers to the first 20 years, medium term refers to 21 to 100 years from now and the long-term timber supply is more than 100 years from now. Short- and medium-term timber supply is determined by factors that affect access to and yields from existing stands while long-term timber supply is largely determined by yields from managed stands.

5.1 Sources of uncertainty to which the base case shows moderate or high sensitivity

Analysis was performed in order to determine the sensitivity of the base case harvest flow to a number of sources of uncertainty. The results showed no impact in the short-term timber supply for all examined sources. However some sources of uncertainty had an impact in the medium and the long term. Results of these sensitivity analyses are summarized in Table 3 and discussed in the following sub-sections of Section 5.1.

5 Timber Supply Sensitivity Analyses

Table 3. Summary of sensitivity analyses indicating moderate impact on the base case harvest forecast

Sensitivity analysis	Impact on harvest forecast relative to the base case		
	Short term	Medium- or long-term	Long-term harvest level
Timber harvesting land base decreased by 5%	None	4 decades less at initial harvest level	3% lower than base case
Timber harvesting land base increased by 5%	None	8 decades more at initial harvest level	4% higher than base case
Volume estimates for existing stands increased by 10%	None	8 decades more at initial harvest level	None
Volume estimates for existing stands decreased by 10%	None	7 decades less at initial harvest level	None
Volume estimates for regenerated stands increased by 10%	None	Flat line from initial harvest level	16% higher than base case
Volume estimates for regenerated stands decreased by 10%	None	4 decades less at initial harvest level	6% lower than base case
VQO 10% more constraining	None	1 decade less at initial harvest level	None
VQO 10% less constraining	None	2 decades more at initial harvest level	4% higher than base case
Minimum harvestable ages increased by 10 years	None	2 decades less at initial harvest level	None
Minimum harvestable ages decreased by 10 years	None	2 decades more at initial harvest level	None
Old-growth site index adjustments applied to managed stands	None	Harvest level increases 10% in decade 8	10% higher than base case
100% of old-seral requirements met immediately	None	2 decades less at initial harvest level	None
No old-seral requirements applied	None	2 decades more at initial harvest level	None
Harvest rule – absolute youngest first	None	2 decades less at initial harvest level	None
Harvest rule – random	None	Less in decades 8-10, 17-20	None

5.1.1 Uncertainty in the estimated area of the timber harvesting land base

Uncertainty in the estimated size of the timber harvesting land base results from factors such as fluctuations in timber prices, changes in the definition of problem forest types, changes in harvesting and milling technology and land-use decisions.

Another factor is the uncertainty around the use of regional or provincial averages in defining the land base when localized data are not available. For example, because local stream and fish habitat inventories were not available for the Okanagan TSA, average interior figures were used to estimate land base reductions for riparian reserves.

Two sensitivity analyses were performed to assess the impact on the base case of over- or under-estimating the size of the timber harvesting land base. The first evaluates the outcome of increasing the size of the timber harvesting land base by 5% and the second demonstrates the impact of a 5% decrease in the size of the timber harvesting land base. Table 4 shows the base case and shifted land bases for the sensitivity analyses. Figure 15 shows the resulting harvest forecasts.

Table 4. Areas assumed in the base case and land base sensitivity analysis

Forecast	Timber harvesting land base (hectares)	Forest outside timber harvesting land base (hectares)	Total (hectares)
Base case	1 072 357	369 276	1 441 632
Reduce timber harvesting land base by 5%	1 018 739	422 895	1 441 632
Increase timber harvesting land base by 5%	1 125 975	315 657	1 441 632

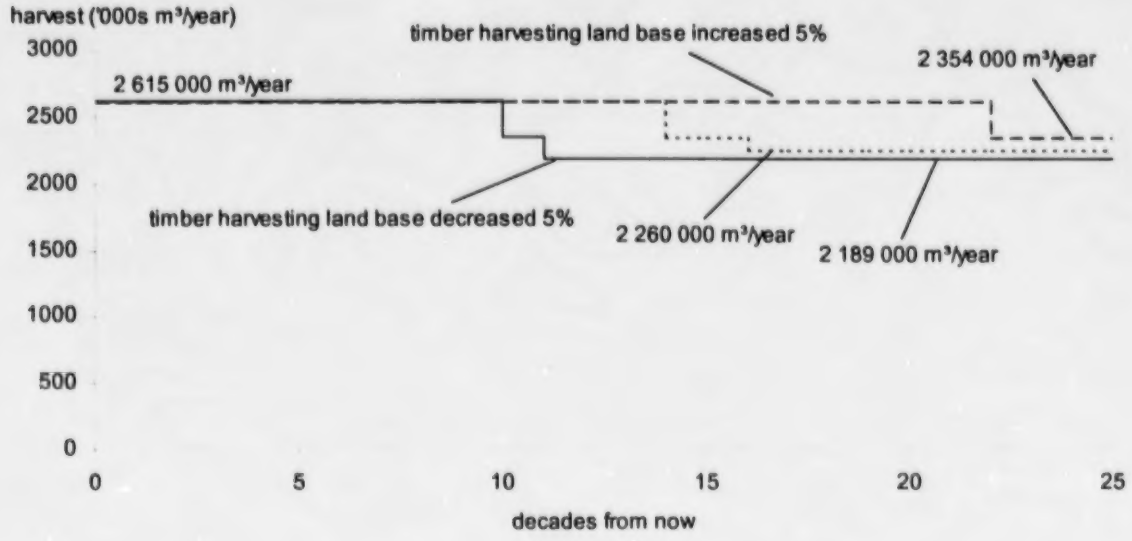


Figure 15. Harvest forecasts if changes to the timber harvesting land base occur — Okanagan TSA, 2000.

The sensitivity analysis shows that if the timber harvesting land base were over-estimated in the base case, there is still sufficient area in older existing stands to support the initial harvest for 10 decades. After 10 decades the projected harvest then decreases by 10% and remains at that level for one decade before declining an additional 7% to a long-term harvest level of 2 189 000 cubic metres per year.

If the timber harvesting land base were larger than is represented in the base case, the transition to harvesting predominately second-growth managed stands is delayed. This delay results in older, higher volume second-growth stand being harvested during the transition period. The combination of higher volume second-growth stands and the addition of more existing stands permits the initial harvest level of 2 615 000 cubic metres per year to be maintained for an additional eight decades before declining 10% to a long-term harvest level of 2 354 000 cubic metres per year.

5.1.2 Uncertainty in the estimated existing stand yields

Timber volume estimates for existing unmanaged stands are subject to uncertainties in the forest inventory data used to estimate timber volumes (i.e., estimated tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Although no specific issues were identified for the Okanagan TSA a standard sensitivity analysis was performed. The results of decreasing and increasing existing unmanaged stand yields (yield curves created through VDYP) by 10% are presented in Figure 16.

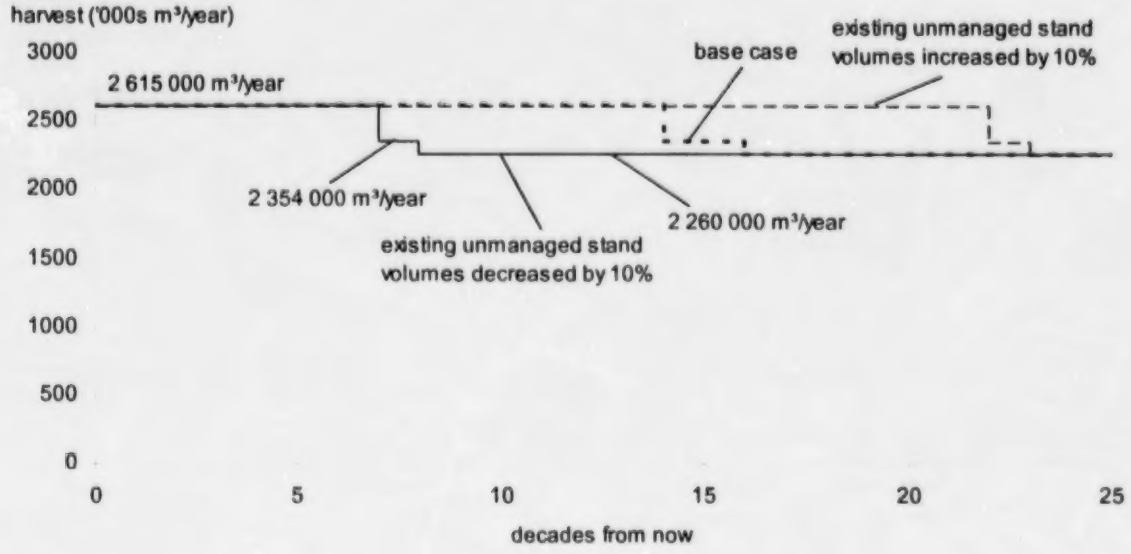


Figure 16. The effect on the harvest forecast of increasing and decreasing volume estimates for existing unmanaged stands — Okanagan TSA, 2000.

Figure 16 shows that if existing unmanaged stand volumes are decreased by 10%, the initial harvest level of 2 615 000 cubic metres per year can be maintained for only seven decades rather than the base case value of 14 decades. During decade 8 the harvest level declines by 10% to 2 354 000 cubic metres per year. In decade 9 there is a further 4% decline to the base case long-term harvest level of 2 260 000 cubic metres per year. Because it is necessary for the managed stand yields to attain minimum harvestable age before the transition to harvesting managed stands can occur, the harvest of existing stands is distributed over a longer time period until the harvest level can be supported solely by the harvest of managed stands.

When existing unmanaged stand volumes are increased by 10%, the transition to harvesting managed stands is delayed and the initial harvest level of 2 615 000 cubic metres per year can be maintained for 22 decades rather than the base case projection of 14 decades.

5.1.3 Uncertainty in the estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and available data for regenerated managed stands in B.C. There is also uncertainty around the site productivity assigned to older unmanaged stands relative to the site productivity expressed by the stands after they regenerate. This issue is examined in Section 5.1.6, "Uncertainty in the productivity of current old-growth sites after harvest."

As with existing unmanaged stand yield estimates, there are no specific issues directly related to managed stand yield estimation in the Okanagan TSA, other than site productivity estimates. However, concerns were raised about the Operational Adjustment Factors (OAFs) that were used to develop the managed stand yield curves. The presence of root rot introduces significant uncertainty in the OAFs assumed in the base case.

A sensitivity analysis, in which managed stands yields were increased and decreased by 10%, was performed. The results are presented in Figure 17. When yields from managed stands are decreased by 10%, the initial harvest level can be maintained for 10 decades before declining to a long-term harvest level of 2 118 000 cubic metres per year by decade 12.

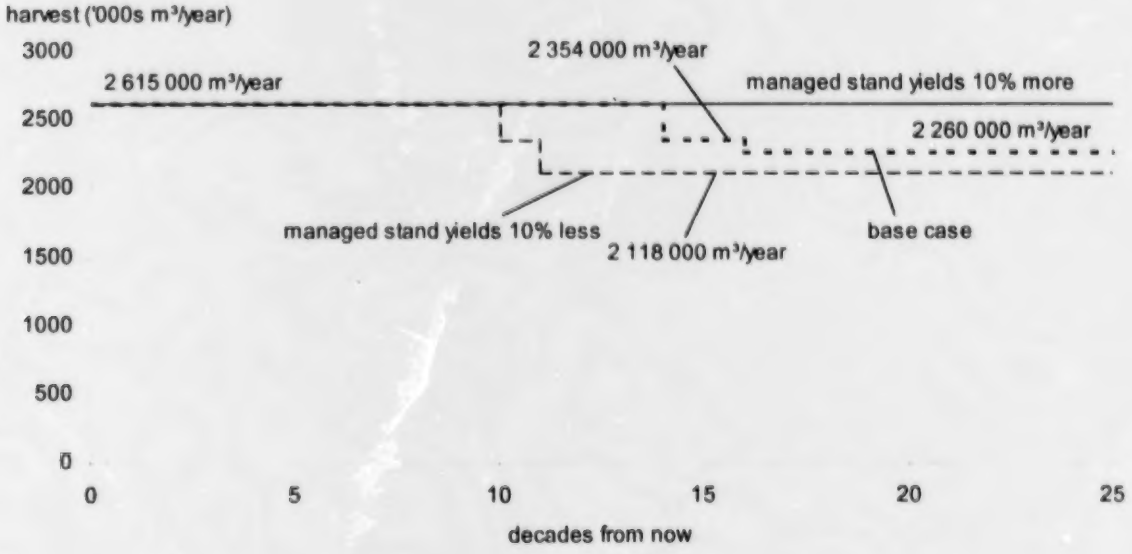


Figure 17. The effect on the harvest forecast of increasing and decreasing volume estimates for managed stands — Okanagan TSA, 2000.

When yields are increased by 10%, a non-declining harvest level of 2 615 000 cubic metres per year can be maintained for the duration of the 250-year planning period.

5.1.4 Uncertainty in constraints applied to visually sensitive areas

To meet visual quality objectives, constraints are placed on timber harvesting within visually sensitive areas. The constraints applied in the base case are a function of the current visual quality rating and the visual absorption capability of the landscape. Uncertainty about forest cover objectives for visual quality may arise from inventory and classification of land into visual absorption capacity classes, from estimates of how well different disturbance limits may meet visual objectives, and from estimates of how non-harvestable forest may contribute to visual quality. The constraint levels are currently under discussion at the land and resource management plan (LRMP) table and may be revised following completion of the LRMP.

Figure 18 shows the effect on timber supply of increasing or decreasing the allowable visual disturbance assumed in the base case by 10% for all visual quality objectives in the Okanagan TSA.

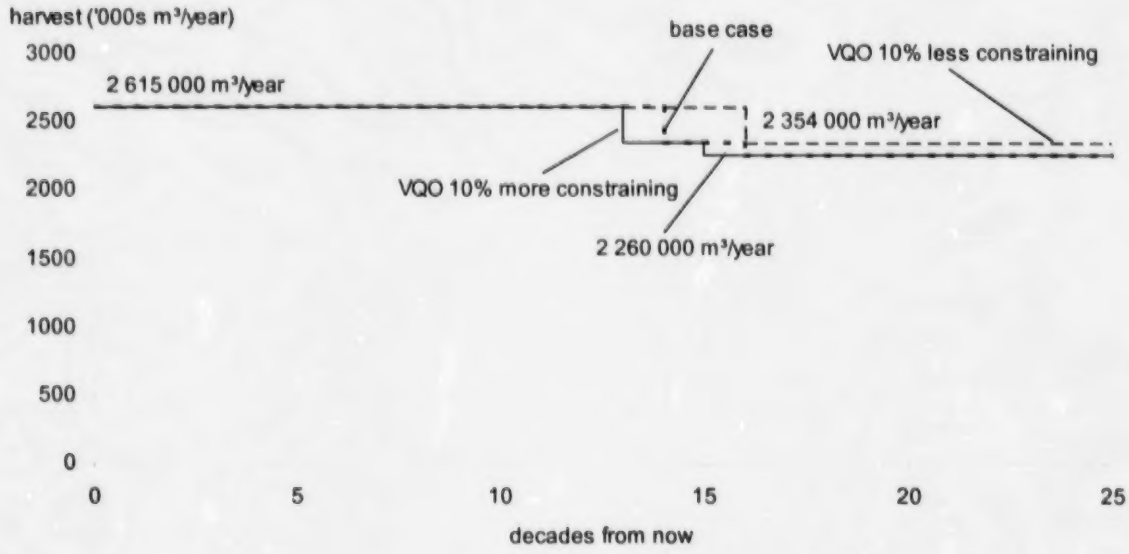


Figure 18. The effect on the harvest forecast of increasing and decreasing forest cover constraints for visually sensitive areas by 10% — Okanagan TSA, 2000.

If the constraints are relaxed by 10%, the initial harvest level of 2 615 000 cubic metres per year can be maintained until the end of decade 16 — an additional three decades compared to the base case projection. Relaxing the constraints provides more rapid access to timber within visually sensitive areas than in the base case forecast. The increased access to existing stands extends the transition period from existing to managed stands. Long-term timber supply is also increased.

If the constraints are increased by 10%, the initial harvest level may be maintained for eleven decades instead of the thirteen decades projected in the base case. The rotation age for stands within visually sensitive areas is increased, and the harvest level becomes more dependent on managed stands outside of the visually sensitive landscapes.

5.1.5 Uncertainty in the minimum harvestable age

Minimum harvestable ages (MHAs) are subject to uncertainty for a variety of reasons. Since different species can grow at different rates on the same site and the same species can grow at different rates on sites of different productivity, it is difficult to determine an average MHA. Fluctuations in markets and mill requirements affect the size of the timber required, thereby influencing the minimum harvestable age of a stand.

Figure 19 shows the potential impact of increasing and decreasing MHAs by 10 years for each species. A 10-year decrease in MHAs results in an additional two decades of harvest at the initial harvest level of 2 615 000 cubic metres per year. This is due to the managed stands becoming available for harvest earlier.

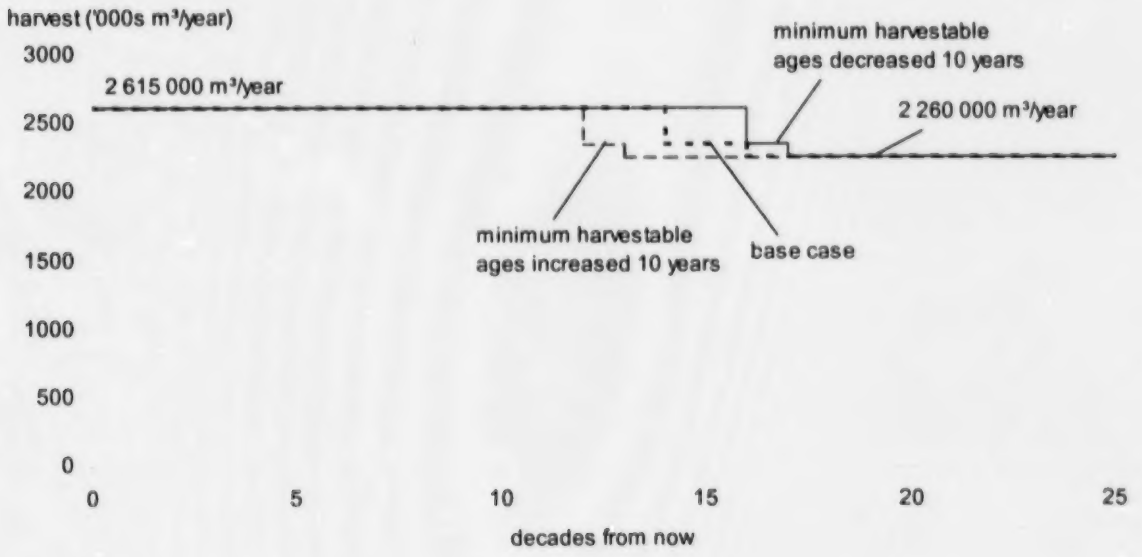


Figure 19. The effect on the harvest forecast of increasing and decreasing minimum harvestable ages by 10 years — Okanagan TSA, 2000.

A 10-year increase in MHAs reduces the period that the initial harvest level can be maintained from 14 decades to 12 decades. Because managed stands do not become available for harvest as soon as in the base case projection, medium-term timber supply is more dependent on the harvesting of existing stands rather than regenerating stands.

5.1.6 Uncertainty in the productivity of current old-growth sites after harvest

Estimating the future productivity of sites currently occupied by existing old-growth forest is difficult in that it is not possible to know with certainty how the productivity of a regenerated stand will compare to the productivity of the existing stand it replaces. The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought can affect the data used to estimate overall productivity for the stand. At older ages, site productivity estimates may be incorrect because tree heights do not represent actual productivity — for example due to top breakage — and it is very difficult to determine ages of old trees accurately. The results of recent province-wide research suggest that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two *Old Growth Site Index* (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for Douglas-fir, lodgepole pine, and interior spruce.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with veteran and main stand components. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

Use of the results of the aforementioned studies is of particular interest to the Okanagan TSA, as stands older than 140 years comprise 35% of the timber harvesting land base. To test the sensitivity of the base case harvest forecast to uncertainty about site index estimates, a sensitivity analysis was performed. Site indices of these older stands were adjusted using either the paired plot or veteran-tree results, whichever was applicable. Managed stand volume estimates for those analysis units• affected by changes in estimated future productivity were recalculated based on average adjusted site productivity. Table 5 compares the average forest inventory-based site index for each tree species group to the adjusted site index.

Analysis unit
A grouping of types of forest - for example, by species, site productivity, silvicultural treatment, age, and or location, done to simplify analysis and generation of timber yield tables.

Table 5. Average analysis unit site index based on forest inventory and old-growth site index information

Analysis unit	Lead species	Base case site index (m @ 50 years)	OGSI adjusted site index	Site index increase	Per cent (%) increase	Timber harvesting land base area (hectares)
12	Fd	13.03	16.31	3.28	25	2 176
15	Fd	17.15	18.87	1.72	10	40 647
16	Fd	12.81	16.17	3.36	26	17 355
19	Ce	17.37	20.69	3.32	19	16 363
20	Ce	14.29	20.69	6.40	45	19 578
23	He	15.86	20.03	4.17	26	5 549
24	He	12.49	18.20	5.71	46	23 930
27	Ba	14.06	16.81	2.75	20	14 229
28	Ba	11.10	15.13	4.03	36	56 512
31	Sx	15.20	20.42	5.22	34	27 840
32	Sx	10.35	19.48	9.13	88	57 456
35	Pl	16.02	20.17	4.15	26	35 522
36	Pl	11.76	19.04	7.28	62	13 509
						330 666[a]

(a) The OGSI adjustments apply only to stands older than 140 years. Hence, the total area subject to the adjustments comprises only a portion (about 31%) of the timber harvesting land base.

5 Timber Supply Sensitivity Analyses

Results of the OGSI sensitivity analysis are presented in Figure 20. The graph shows that after two decades the initial harvest level increases by 7% to a long-term harvest level of 2 798 000 cubic metres per year, 24% higher than the long-term harvest level depicted in the base case.

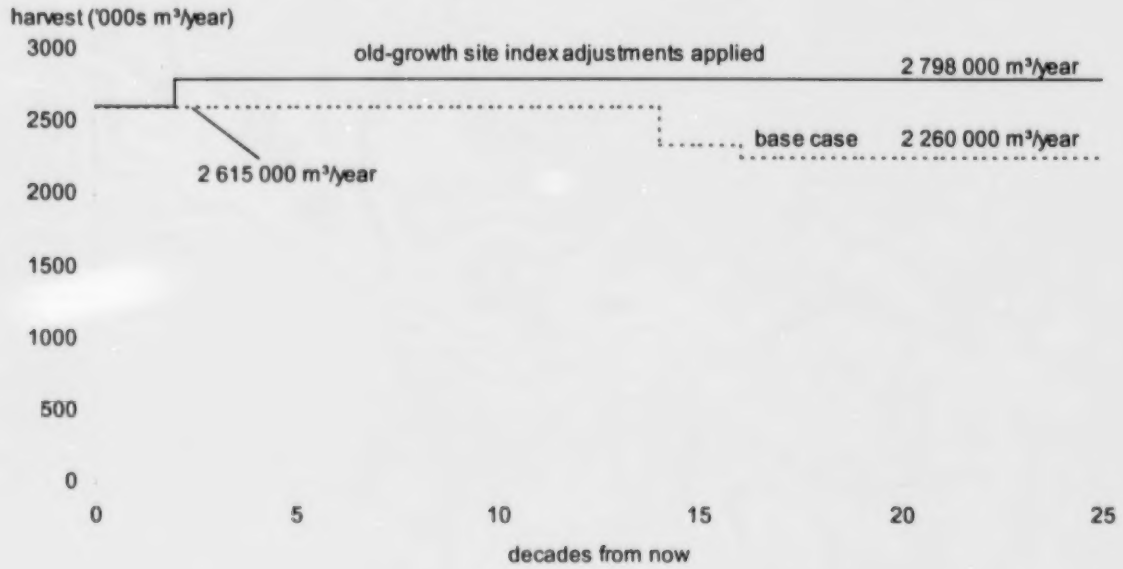


Figure 20. Harvest forecast based on OGSI (paired plot and veteran tree studies) site index adjustments — Okanagan TSA, 2000.

The OGSI adjustments are not included in the base case because the adjustments are not based on data specific to the Okanagan TSA. Therefore the results of the sensitivity analyses included in this section need to be viewed with the following cautions:

- The difference in site productivity between the thrifty (intermediate aged) and older components of the tree species groups is on average less than one metre. Frequently, larger site index differences are observed between the younger and older stands. The small difference in the Okanagan TSA might indicate that the site index of the old component may not be underestimated to the extent generally suggested in the OGSI studies. However, no local information is available to validate this observation.
- The results of the OGSI studies provide generalized site index adjustments. No specific studies were performed to calibrate the results for the Okanagan TSA. Therefore, the results of the sensitivity analyses only provide insight into the possible trends associated with changes in site productivity information.
- The OGSI studies provide site index adjustments that represent the maximum potential level for the tree species. There has been no accounting for site and management factors such as stocking and local climate.

5.1.7 Uncertainty in the application of old-seral stage requirements

Provincial policy aimed at managing landscape-level biodiversity specifies a minimum percentage of the forest within each landscape unit/biogeoclimatic variant combination that must be retained in old forest. The percentage that must be retained depends on the biodiversity emphasis assigned to the landscape unit. Given that specific biodiversity emphases have not yet been designated for each individual landscape unit in the Okanagan TSA, in the base case old-seral requirements were calculated assuming a distribution of 45% lower biodiversity emphasis, 45% intermediate biodiversity emphasis and 10% higher biodiversity emphasis. In the base case, one-third of the old-seral requirement in the lower biodiversity emphasis areas is required to be met immediately with the full requirement being phased in over three rotations.

Two sensitivity analyses were completed to test the uncertainty associated with the base case assumptions. The first tested the impact of removing all old-seral retention requirements. In a second sensitivity analysis, no "drawdown" was assumed and 100% of the old-seral constraint in the lower BEO was required to be met immediately.

The results, illustrated in Figure 21, showed no impact on the short- or long-term timber supply, and a small effect in the medium term compared to the base case.

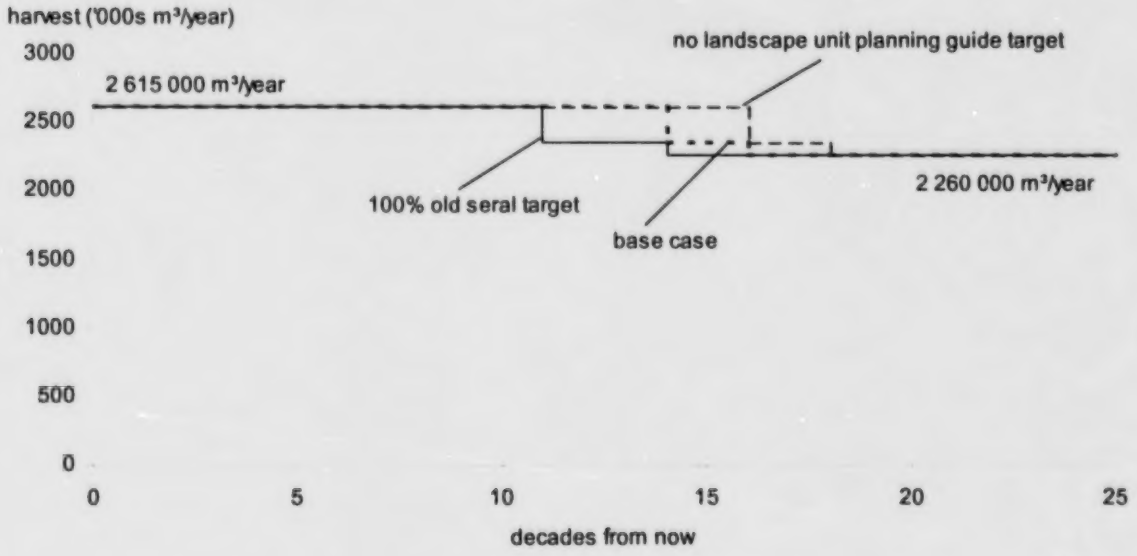


Figure 21. Harvest forecasts if 100% of old-seral requirements are to be met immediately, and if old-seral requirements are removed entirely — Okanagan TSA, 2000.

5.1.8 Alternative harvest queue rules

In the base case, highest priority for harvest is given to stands that are the oldest relative to their minimum harvestable age. This relative oldest first rule is applied only after other requirements and priorities (e.g., forest cover requirements) are taken into account. This rule reflects the practice of favouring older stands, but not necessarily the oldest, for harvest when all other considerations have been met.

Besides the relative oldest first rule, the Forest Service Simulator (FSSIM) model permits use of absolute oldest first, absolute youngest first or random harvest rules. These other rules may better reflect practices in some instances, given unforeseeable operational constraints that may affect when stands are usually harvested.

Two sensitivity analyses were completed to test the uncertainty associated with the base case assumptions. If the absolute youngest first rule is substituted for the relative oldest first rule, the resulting forecast is similar to the base case except that the initial harvest level can be maintained for only 12 decades compared to the 14 decades projected in the base case. This small decrease in timber supply occurs because the absolute youngest harvest rule causes some stands in some decades to be harvested at their minimum harvestable ages, before maximum average annual growth rate is realized.

Substituting the relative oldest forest harvest rule with a random harvest rule reduced medium-term timber supply compared to the base case during decades 8 to 10, and 17. Harvesting using the random harvest age rule queues stands older than the minimum harvestable age in a random order. The decrease in timber supply occurs because with a random harvest rule, there is an increased chance of stands being harvested further away from the age of maximum average annual growth.

5.2 Uncertainties to which the base case showed little or no sensitivity

The base case harvest forecast showed little or no sensitivity to some sources of uncertainty. These sources, and results of the sensitivity analyses are summarized in Table 6.

Table 6. Summary of sensitivity analyses suggesting little or no effect on the base case harvest forecast

Sensitivity analysis	Impact on harvest forecast relative to the base case		
	Short term	Medium- or long-term	Long-term harvest level
Green-up occurs 5 years earlier	None	None	None
Green-up occurs 5 years later	None	None	None
Hydrologic green-up* changed from 30% at 28 years to 25% at 28 years	None	74 000 cubic metres/year shortfall in decade 14	None

Hydrologic green-up (height)
The height a stand must reach for it to provide the same timing and quantity of water yields as old-growth.

6 Summary and Conclusion of the Timber Supply Analysis

Based on current forest management practices and existing inventory information, the results of this timber supply analysis suggest that the current allowable harvest level of 2 615 000 cubic metres per year in the Okanagan TSA can be maintained for 140 years without requiring rapid or disruptive reductions to long-term harvest levels. The initial harvest level is followed by a decline of 10% to 2 354 000 cubic metres per year for two decades and a further decline of 4% at the start of decade seventeen. The harvest then remains at 2 260 000 cubic metres per year from decade 17 onward.

The base case results described above reflect current knowledge and information on forest inventory, growth and management. However, uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties affect timber supply to varying degrees, some having a positive impact and others a negative impact on timber supply.

In some management units, short-term timber supply (the present to 20 years from now) can be sensitive to changes which influence the amount of timber available from existing unmanaged stands, because the harvest forecast relies on harvests from these stands for the next 60 years. However, due to the robust nature of the timber supply in the Okanagan TSA the short-term timber supply is insensitive to any of the factors for which sensitivity analyses were completed. The *Okanagan Shuswap* LRMP has the potential to have the greatest impact on the base case projected harvest levels over the short term, as it will most likely affect the size of the timber harvesting land base and the forest cover constraints applied to the forested land base. The LRMP is not yet complete nor has it been presented to Cabinet for official designation; therefore the impacts of its eventual recommendations are unknown and have not been included in this analysis. However, the Chief Forester will consider available LRMP information when making his determination.

Medium-term (21 to 100 years from now) timber supply is affected most significantly by changes to harvest priority, existing stand yields, managed stand yields, forest cover requirements for management of visual quality, as well as adjustments to old-growth site index. If stands are harvested more randomly than in the base case, the medium-term harvest forecast could be reduced. If managed stand yields are 10% lower than predicted in the base case, the medium- and long-term harvest forecast is reduced. While visual quality guidelines apply to 23% of the timber harvesting land base, they have a minor effect on both medium- and long-term timber supply because there is a significant amount of forest outside the timber harvesting land base that contributes to meeting visual quality objectives. If site index is underestimated in old-growth stands, as suggested by recent research, yields in the medium- and long-term could be significantly higher than in the base case harvest forecast.

Long-term (over 100 years from now) timber supply is affected by uncertainties in all the above factors with the exception of changes to existing stand yields.

A summary of sensitivity analyses showing the impact relative to the base case is presented in Tables 3 and 6. All sensitivity analyses showed medium- to long-term impacts on timber supply but no short-term impact.

In conclusion, this analysis indicates that based on current inventory and growth and yield information, and the current management regime, timber harvests in the Okanagan TSA can be maintained at the current level for the next 140 years. The analysis indicates that several factors related to the current forest inventory and management regime could affect timber supply. However with the exception of site index estimates for old-growth stands, there is no conclusive evidence to suggest that significant inaccuracies exist in the information used in this analysis. Also the possibility of changes to the land base and forest cover constraints as a result of the *Okanagan Shuswap* LRMP will be considered by the Chief Forester at the time of the AAC determination, if the LRMP is approved and implementation details are known.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the Timber Supply Review. This socio-economic analysis assesses the level of forestry activity supported by short- to long-term current and projected timber supply in the Okanagan TSA.

The socio-economic analysis includes:

- a profile of the current socio-economic setting;
- a description of the Okanagan TSA forest industry; and,
- an analysis of the socio-economic implications of the base case harvest forecast.

The base case is intended to reflect current forest management practices. Consequently, the socio-economic analysis does not evaluate alternative management scenarios.

7.1 Current socio-economic setting

7.1.1 Overview

The socio-economic analysis focuses on the timber supply from the Okanagan TSA, located in the southern portion of the British Columbia interior. The Okanagan TSA comprises approximately 2.2 million hectares and is administered by the Salmon Arm, Vernon and Penticton forest districts.

7.1.2 Population and demographic trends

According to the 1996 Census, the population of the Okanagan TSA increased 19% since 1991 to 313,000. In comparison, the population of the province increased by 14% over the same period. Much of the growth can be attributed to improved highway links with the completion of the Coquihalla Highway, quality of life issues (pleasant climate, scenic values, recreational amenities) and new opportunities offered by a growing economy. The population of the Okanagan TSA is concentrated in Kelowna (89,400), Vernon (31,800), Penticton (31,000) and Salmon Arm (14,700).

Of the three forest districts that comprise the TSA, the Penticton Forest District encompasses most of the area's population (see Table 7). The rate of population growth was greatest in the Salmon Arm Forest District. Of B.C. municipalities with more than 5,000 people, the municipality of Salmon Arm experienced one of the top 12 growth rates since the last census.

Table 7. Population and growth by forest districts in the Okanagan TSA

	1996 Population	Average annual growth rate since 1991 (%)	1996 population as % of TSA (%)
Salmon Arm Forest District	38,939	4.4	12
Salmon Arm	14,664	4.2	5
Rest of district	24,275	4.5	8
Vernon Forest District	76,534	3.2	24
Vernon	31,817	3.0	10
Rest of district	44,717	3.4	14
Penticton Forest District	197,334	3.9	63
Kelowna	89,442	3.6	29
Penticton	30,987	2.7	10
Rest of district	76,905	4.8	25

Source: BC STATS.

Population growth in the Okanagan TSA is expected to continue at rates exceeding provincial averages. Forecasts for annual growth rates over the next few years fall in the range of 2.5–2.7%, with the growth rate declining as the forecast moves further into the future. At this rate of growth, population in the TSA would reach about 440,000 by 2010, and 540,000 by 2020.

7.1.3 Economic profile

The unemployment rate in the TSA in 1999 was about 8.5%[1], slightly higher than the provincial average of 8.3%. The TSA is economically well diversified, relying on agriculture, forestry, tourism, manufacturing and the retirement industry in varying degrees. The Okanagan Valley's three largest cities have all developed as regional commercial and administrative centres, with Kelowna ranking first in this regard. The economy of the area will benefit from the continuing expansion of tourism, the increasing prominence of the Okanagan as a retirement centre, an expanding agricultural sector, improved utilization of the forest resource and expansion of the manufacturing base.

(1) Estimated from 1996 Census (Okanagan TSA) and 1999 Labour Force Survey (Kelowna).

During 1998, about 3,000 workers were directly employed at Okanagan TSA mills. Figure 22 illustrates the shares of total employment by industry sector for the Okanagan TSA.

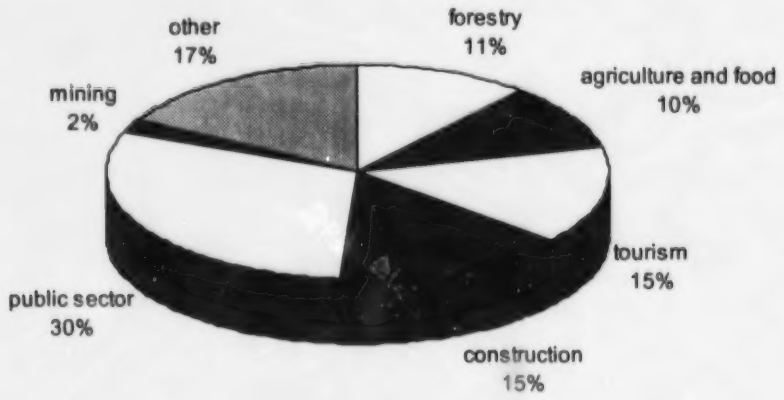


Figure 22. Total employment by sector for Okanagan TSA, 1996.[2]

Note: The figures are for the Okanagan TSA. Percentages reflect direct, indirect, and induced employment supported by the basic sector. "Other" (basic sectors) consists of some manufacturing, and transportation.

The forest sector supports other jobs in the region through companies and employees purchasing goods and services from local businesses. This spending also reflects the role of forestry in the economy. Each 100 direct forestry jobs in the Okanagan TSA are estimated to support a further 33 to 67 indirect and induced jobs, depending on the type of forestry activity (logging or wood manufacturing) and the associated level of income. The weighted average for the forest sector is 35 positions for each 100 direct forestry jobs. In comparison, each 100 mining and mineral processing jobs support approximately 55 positions, each 100 public sector jobs support 16 positions, while each 100 tourism jobs support about seven positions.

A breakdown of income dependencies highlights the economic diversity of the TSA. Only about 6.5% of all basic, after tax income (excluding induced impacts) is forestry dependent, accounting for about 7.5% of the direct and indirect forestry related local employment.

(2) B.C. Ministry of Finance and Corporate Relations. 1999. *The 1996 Forest District Tables*.

7.2 Okanagan TSA forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Okanagan TSA is 2.615 million cubic metres, unchanged from the previous determination. The AAC is apportioned by the Minister of Forests into the licence types outlined in Table 8. Seven major ventures have forest licences in the TSA (Riverside Forest Products, Weyerhaeuser Canada, Federated Co-operatives, Tolko Industries, Gorman Bros., Louisiana-Pacific Canada and Bell Pole) accounting for 82% of the total AAC. The remainder is apportioned among other forms of tenure including timber sale licences and the Small Business Forest Enterprise Program (SBFEP).

Table 8. Allowable annual cut apportionment, Okanagan TSA, 1999

Type of licence	Volume (m^3/year)	Per cent (%)
Forest licences, replaceable	2 138 867	81.8
Forest licences, non-replaceable	15 000	0.6
Timber sale licences, replaceable	35 936	1.4
Small Business Forest Enterprise Program (SBFEP) — all categories	361 974	13.8
Woodlot licences	37 073	1.4
Forest Service Reserve	26 150	1.0
Total	2 615 000	100.0

Source: B.C. Ministry of Forests. 1999.

7.2.2 Okanagan TSA harvest history

The actual annual harvest level is an important indicator of forestry activity in the TSA. While the AAC is the allowable annual harvest level, the actual volume of timber harvested in a particular year indicates the economic activity supported by the TSA. If actual annual harvest levels are consistently less than the AAC, then economic activity is below its full potential. This gap between actual and allowable harvest activity will influence the potential short-term impacts of changes to the AAC.

From 1996 to 1999, approximately 2.910 million cubic metres of Crown timber were harvested annually from the Okanagan TSA. Additional (non-AAC) sources of timber include private lands and Indian reserves, which amounted to about 260 000 cubic metres per year over the same period. Three tree farm licences (TFLs) also supply timber and employment in the region: TFL 49 (Riverside Forest Products) with an AAC of 380 000 cubic metres, TFL 15 (Weyerhaeuser Canada) with an AAC of 70 000 cubic metres, and TFL 33 (Federated Co-operatives) with an AAC of 22 500 cubic metres. The Okanagan TSA makes up about 35% of the total harvest in the Kamloops Forest Region (8.8 million cubic metres). The region, in turn, accounts for about 12% of the total provincial harvest (73 million cubic metres).

Table 9 summarizes the volume of timber harvested in the Okanagan TSA from 1996 to 1999. It indicates a fairly constant harvest level over the period. Cut control provisions, which allow harvest volumes to vary from licensed volumes, enable the licensees to respond to market conditions and other factors.

Table 9. Okanagan TSA volumes billed, by licence type, 1996–1999

Tenure	1996 (m^3)	1997 (m^3)	1998 (m^3)	1999 (m^3)	Average 1996-1999 (m^3)
Forest licences	2 264 808	2 084 515	1 870 692	2 173 951	2 098 492
Small Business Forest Enterprise Program (SBFEP)	365 794	281 531	417 040	691 307	438 918
Other[a]	372 206	353 368	360 346	399 857	371 444
Total	3 002 808	2 719 404	2 648 078	3 265 115	2 908 854

Source: B.C. Ministry of Forests.

(a) "Other" consists of cutting permits such as rights-of-way, road permits, woodlot licences and other smaller permits.

7.2.3 Okanagan TSA major licensees

Weyerhaeuser Canada Ltd.

Weyerhaeuser Canada Ltd. (Weyerhaeuser) has a replaceable forest licence to harvest 380 031 cubic metres per year in the Okanagan TSA. In addition, Weyerhaeuser holds 10 other licences throughout the province, including those of the former Macmillan Bloedel. Its total of 7.2 million cubic metres per year of allowable harvest make Weyerhaeuser the largest tenure holder in British Columbia. Table 10 outlines Weyerhaeuser's recent harvest activity in the Okanagan TSA and the associated employment levels.

Weyerhaeuser is North America's largest producer of softwood lumber for residential and commercial construction. In 1998, the company's lumber operations produced 3.8 billion board feet of dimension lumber from operations in three geographic regions: western Canada, the U.S. Pacific Northwest and the south-eastern U.S. Lumber sales in 1998 were nearly $1.8 billion. Weyerhaeuser operates 11 mills in British Columbia and employs about 3,000 people.

Weyerhaeuser operates a large lumber mill, employing 180 people, in the Penticton Forest District at Okanagan Falls. This mill can process almost 450 000 cubic metres annually. Another mill, employing 150 at Lumby in the Vernon Forest District, was shut down in February 2000. A sales office located in Kelowna employs about 8 individuals. Wood chips, which are trucked to the Weyerhaeuser pulp mill in Kamloops, support additional employment. Timber surplus to Weyerhaeuser's TSA operations, which previously fed the Lumby mill, is now trucked to Weyerhaeuser facilities in Kamloops and Princeton.

Table 10. Weyerhaeuser's harvest and direct employment statistics

AAC	380 031 cubic metres
1999 harvest	259 753 cubic metres
1996-1999 average harvest	321 252 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	150
Processing	180

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Riverside Forest Products Ltd.

Riverside Forest Products Ltd. (Riverside) has a replaceable forest licence to harvest 767 413 cubic metres per year in the Okanagan TSA. Riverside is one of British Columbia's top 10 licence holders at 2.3 million cubic metres per year. Table 11 summarizes the harvest activity and employment associated with Riverside's operations in the Okanagan TSA.

Riverside operates lumber/chip, plywood and veneer complexes in the TSA at Kelowna, Armstrong and Lavington, with a combined annual capacity of approximately 2.0 million cubic metres of timber. The plants employ about 1,000 people.

Table 11. Riverside's harvest and direct employment statistics

AAC	767 413 cubic metres
1999 harvest	770 260 cubic metres
1996-1999 average harvest	814 794 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	380
Processing	570

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Tolko Industries Ltd.

Tolko Industries Ltd. (Tolko) has a replaceable forest licence to harvest 234 228 cubic metres per year in the Okanagan TSA. Tolko is a private, family-owned company whose primary business is marketing and manufacturing specialty forest products. Founded in 1961, the company was originally incorporated as Lavington Planer Mill Ltd. Today, Tolko has expanded to eight manufacturing divisions and four marketing and sales divisions, with the corporate office located in Vernon.

Tolko operates a sawmill in the Vernon Forest District, with an annual capacity of approximately 500 000 cubic metres. The plant employs about 230 people. Table 12 summarizes the harvest activity and employment associated with Tolko's operations in the Okanagan TSA.

Table 12. Tolko's harvest and direct employment statistics

AAC	234 228 cubic metres
1999 harvest	292 780 cubic metres
1996-1999 average harvest	227 760 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	105
Processing	140

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Gorman Bros. Lumber Ltd.

Gorman Bros. Lumber Ltd. (Gorman Bros.) has a replaceable forest licence to harvest 231 349 cubic metres per year in the Okanagan TSA. The company began in 1951 as a small plant manufacturing boxes for the local fruit industry. Since then, Gorman Bros. has become one of the largest family-owned wood products operations in British Columbia.

Gorman Bros. operates a sawmill in Westbank and a pole operation in Lumby. Collectively, the plants have an annual capacity of approximately 350 000 cubic metres and employ about 250 people. Value-added items such as finger-jointed and molding stock, and pattern stock produced to order is trucked from the Westbank site directly to customers or to reload yards in Kelowna and in Oroville, Washington. Table 13 summarizes the harvest activity and employment associated with Gorman Bros.' operations in the Okanagan TSA.

Table 13. Gorman Bros. harvest and direct employment statistics

AAC	231 349 cubic metres
1999 harvest	285 812 cubic metres
1996-1999 average harvest	250 522 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	120
Processing	190

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Louisiana-Pacific Canada Engineered Wood Products Ltd.

Louisiana-Pacific Canada Engineered Wood Products Ltd. has a replaceable forest licence to harvest 140 217 cubic metres per year in the Okanagan TSA. Table 14 summarizes the harvest activity and employment associated with Louisiana-Pacific operations in the Okanagan TSA. The parent company, Louisiana-Pacific Corp. of Portland, Oregon, acquired the licence when it purchased Evans Forest Products Ltd. in 1999. The purchase expands Louisiana-Pacific's ability to make engineered wood and lumber, which are gaining wide acceptance in the building industry.

Louisiana-Pacific operates a sawmill in Malakwa (Salmon Arm Forest District) with an annual capacity of approximately 225 000 cubic metres. The plant employs 125 people. The company also operates a plywood and veneer facility in Golden (Golden TSA). In 1998, the Golden and Malakwa facilities processed almost 450 000 cubic metres of timber and employed about 400 people.

Table 14. Louisiana-Pacific's harvest and direct employment statistics

AAC	140 217 cubic metres
1999 harvest	171 784 cubic metres
1996-1999 average harvest	137 876 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	65
Processing	105

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Federated Co-operatives Ltd.

Federated Co-operatives Ltd. (Federated) has a replaceable forest licence to harvest 332 963 cubic metres per year in the Okanagan TSA. Federated employs roughly 300 people in its sawmill and plywood plant located at Canoe (Salmon Arm Forest District). Table 15 summarizes the harvest activity and employment associated with Federated operations in the Okanagan TSA.

Table 15. Federated's harvest and direct employment statistics

AAC	332 963 cubic metres
1999 harvest	327 542 cubic metres
1996-1999 average harvest	306 559 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	145
Processing	270

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Bell Pole Ltd.

Bell Pole Ltd. (Bell) has a replaceable forest licence to harvest 45 286 cubic metres per year in the Okanagan TSA. Bell employs about 30 people in its Lumby (Vernon Forest District) mill. Table 16 summarizes the harvest activity and employment associated with Bell operations in the Okanagan TSA.

Table 16. Bell Pole's harvest and direct employment statistics

AAC	45 286 cubic metres
1999 harvest	66 019 cubic metres
1996-1999 average harvest	39 730 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	20
Processing	30

Note: The employment figures relate to only the volumes harvested from the Okanagan TSA land base.

Other licensees

Other licensees in the Okanagan TSA are mainly comprised of Small Business Forest Enterprise Program (SBFEP) participants with an AAC apportionment of 361 974 cubic metres. From 1996 to 1999, SBFEP harvests averaged 438 918 cubic metres annually, which would normally support about 450 direct harvesting, silviculture and processing person-years.

Other processing facilities

In addition to the mills discussed previously, several other lumber, log home and post and pole facilities operate in the Okanagan TSA. Recent statistics indicate that these facilities process some 260 000 cubic metres of timber and employ about 625 persons.

7.2.4 Forest sector employment summary

In this section, the preceding harvesting and employment information is considered in the development of employment coefficients used to project future employment levels. For this purpose, the forest sector has been divided into the following three sub-sectors:

- harvesting and other woodlands-related employment such as log salvage, log scaling and harvest planning;
- silviculture activity including all planting and other basic and intensive operations; and
- primary timber processing employment.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the most closely tied to the AAC. Consequently, harvest level changes will affect this sub-sector first, and in close to the same proportions.

The silviculture sub-sector is less linked to the current level of harvest, given that silviculture activities can occur up to 12 years after harvesting. Silviculture activity is divided into basic and enhanced work. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive, silviculture includes spacing, fertilization and pruning*. In the Okanagan TSA, licensees are responsible for basic silviculture on areas harvested under forest licences. The provincial government is responsible for the remaining basic silviculture and all enhanced silviculture on Crown land, activities normally completed by silviculture contractors.

> ***Pruning***
> *The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.*

Primary timber processing employment

Processing facilities in the TSA rely on the Okanagan TSA and other TSAs, TFLs, woodlot licences and private lands in the area for their timber supply. Timber from the Okanagan TSA also supports other processors throughout the region and province.

Forest Service employment

The Okanagan TSA is jointly administered by the Salmon Arm, Vernon and Penticton Forest Districts. About 150 people work in the district offices, which oversee the management of forestry related activities on Crown land. Employment is more related to the administration and enforcement of government policy than to timber harvest levels, therefore these jobs are not included in the analysis of direct employment in the forestry sector. Forest Service staff are, nonetheless, an important component of the total employment in the TSA and are accounted for in the government service component of the public sector.

Okanagan TSA forestry employment and employment coefficient summary

Table 17 summarizes employment supported by the 1996-1999 average harvest in the Okanagan TSA, and the corresponding employment coefficients. The employment and coefficients are divided into two groups:

1) TSA employment and employment coefficients, which comprise residents of the Okanagan TSA who are employed within the Okanagan TSA; and,

2) Provincial employment and employment coefficients, which comprise all forest sector employment in the province that relies on the Okanagan timber supply; including both residents of the Okanagan TSA and those who live elsewhere.

Coefficients have been calculated for both groups to identify the importance of the forest sector within the Okanagan TSA and to highlight the contribution that the Okanagan TSA's forest sector makes to the provincial economy.

From 1996 to 1999, the average annual harvest from the TSA was 2.908 million cubic metres, about 10% higher than the AAC. The higher level was largely due to fluctuating lumber markets and the resolution of cut control periods given the cut control regulations[3]. If the harvest had matched the AAC (2.615 million cubic metres) it would likely have supported a slightly lower level of employment.

Table 17. Okanagan TSA employment and employment coefficients

Forest industry activity	TSA employment (person-years)	TSA employment coefficients (person-years per '000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years per '000s m³)
Harvesting	919	0.32	947	0.33
Silviculture	417	0.14	448	0.15
Processing	1,923	0.66	2,248	0.77
Total direct	3,259	1.12	3,644	1.25
Indirect + induced	2,152	0.74	4,425	1.52
Total employment	5,411	1.86	8,069	2.77

Note: Employment estimates are reported in person-years based on average 1996–1999 employment levels and the average 1996–1999 Okanagan TSA harvest of 2.908 million cubic metres. Person-years do not indicate individual jobs. Wood products transport, and road building and maintenance are included in indirect estimates.

For more detailed information regarding employment coefficients, see Appendix B, "Socio-Economic Analysis Background Information."

(3) Over a five-year cut control period the harvest may deviate by up to 10% of the AAC, and may be within 50% and 150% in any one year.

7.2.5 Okanagan TSA provincial employment income

Table 18 shows average annual income, total income and total income per 1000 cubic metres. In 1998, the average annual income for direct forest sector employees was approximately $45,500, and $34,000 for indirect and induced employment (in 1997 dollars). Based on these averages, current harvesting, silviculture and processing of timber from the Okanagan TSA generates an estimated $119.3 million in direct wages and salaries and $116.1 million in indirect and induced wages and salaries, annually, throughout the province.

Table 18. Average annual direct, indirect and induced incomes and total employment income, 1996–1999

	Average annual income ($ 1997)	Total annual income ($ millions)	Total income ($ per '000s m³)
Direct	45,482	119.3	41,021
Indirect + induced	34,075	116.1	39,911
Total income		235.4	80,931

Source: Statistics Canada. 1998. Survey of Employment, Payrolls and Hours.

7.2.6 Provincial government revenues

Provincial government revenues from the forest industry include stumpage, royalties and rent payments; other taxes such as logging, corporate capital, sales, property and electricity taxes; and income taxes from direct, indirect and induced employment.

From 1996 to 1999, average stumpage and rent payments for Crown timber in the Okanagan TSA were approximately $66.5 million per year. Forest and corporate taxes generated $21.6 million, while employment supported by the Okanagan timber harvest accounted for $26.8 million in provincial income taxes (see Table 19).

Table 19. Average annual provincial government revenues, 1996–1999

	Average annual revenue 1996-1999 ($1997 millions)	Revenue ($ per '000s m³)
Stumpage, rents and royalties	66.5	22,868
Industry taxes	21.6	7,427
Provincial income tax	26.8	9,215
Total government revenues	115.0	39,510

7.3 Socio-economic implications of the base case harvest forecast

The base case harvest forecast suggests that the current AAC could be maintained for 140 years. The socio-economic analysis focuses on the base case harvest level in the short- to medium-term, and considers:

- the short- and long-term implications of alternative harvest levels for both the Okanagan TSA and the province;
- possible impacts on the communities within the TSA;
- timber requirements of processing facilities within the Okanagan TSA; and,
- regional timber supply implications.

The socio-economic analysis considers the average levels of forestry activity that the base case harvest forecast could support, assuming that employment changes by the same percentage as the harvest level, and that the proportion of harvesting, processing and silviculture employment remains the same. Because the analysis also assumes that the types and proportions of products manufactured remain constant, it does not attempt to predict how timber flows, technology or product lines may change in response. The analysis indicates the size of impacts to expect within a constantly changing socio-economic environment.

Employment and income impacts are divided into direct, indirect and induced components; the sum of all the components is the total impact. Direct impacts reflect harvesting, silviculture and processing activity. Indirect impacts are the result of direct businesses purchasing goods and services, and induced impacts are the result of direct and indirect employees spending their incomes on consumer goods and services.

Table 20 estimates the range of impacts the base case harvest forecast may have on employment and income. Ranges are used to reflect the availability of employment insurance and social assistance payments, and their mitigating effects in the shorter term. The lower end of the range reflects induced impacts that are diminished in the short term, because employment insurance and social assistance income support displaced workers. The upper end of the range represents long-term impacts when displaced workers leave the area, and local spending patterns are more fundamentally affected. In reality, a combination of these two scenarios — some workers accessing social assistance payments, some finding alternate employment and some leaving the area completely — is more likely to occur.

7.3.1 Short- and long-term implications of alternative harvest levels

Okanagan TSA employment and income impacts

For accounting purposes, TSA employment and income includes only that of workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as is employment supported by Okanagan TSA timber processed at mills outside the TSA. Table 20 indicates the employment and income that could be supported within the Okanagan TSA by the base case harvest forecast.

If fully harvested and processed, the current AAC of 2.615 million cubic metres could support about 2,930 person-years of direct employment and another 1,935 indirect and induced person-years of employment within the TSA. Approximately $150 million total after-tax annual income would be supported by the Okanagan timber supply. Approximately 90% of all direct employees reside within the Okanagan TSA.

Provincial employment and income impacts

Provincial employment and income impacts include all forest sector employment supported by the timber harvested from the Okanagan TSA. Assuming the current AAC of 2.615 million cubic metres is fully harvested and processed, the Okanagan TSA can support at least 3,276 person-years of direct forestry employment and a further 3,978 person-years of indirect and induced employment across the province and contribute $211 million in total after-tax annual income.

Provincial government revenue impacts

Based on current tax and stumpage rates, the AAC of 2.615 million cubic metres has the potential to provide approximately $103.2 million annually to the provincial government (1997 dollars).

The ranges for employment and income changes account for employment insurance and other social assistance programs. The range's upper limit is based on the assumption that all those who are unemployed will leave the TSA. The lower limit is based on the assumption that employment insurance and other social assistance payments will reduce the induced impacts of a lower harvest level.

Table 20. Socio-economic impacts of the Okanagan TSA base case forecast

		Base case harvest forecast
	Current	Years 0-40
AAC ('000s m³)	2 615	2 615
Harvest level (average 1996-1999)	2 908	
Cumulative change	(293)	0
Okanagan TSA		
Employment		(person-years)
Direct	3 259	2 929
Indirect and induced	2 152	1 935
Total	5 411	4 864
Cumulative change in total person-years		– 917 to – 176
Net employment income		($ 1997 millions)
Direct	106	95
Indirect and induced	57	51
Total	163	146
Cumulative change in total income		– 26.1 to – 6.7
Province (includes Okanagan TSA)		
Employment		(person-years)
Direct	3 644	3 276
Indirect and induced	4 425	3 978
Total	8 069	7 253
Cumulative change in total person-years		- 1 466 to – 164
Net employment income		($ 1997 millions)
Direct	119	106
Indirect and induced	116	104
Total	235	211
Cumulative change in total income		– 41.6 to – 7.5
Provincial government revenues		($ 1997 millions)
Provincial income tax	26.8	24.0
Stumpage and rent	66.5	59.9
Other B.C. revenues	21.6	19.4
Total B.C. revenues	114.9	103.2
Cumulative change in total revenue		– 13.4 to – 10.0

Notes:

Provincial employment includes both Okanagan TSA employment and employment supported outside the TSA by timber harvested in the Okanagan TSA.

Income figures in Table 20 are net of taxes while those of Table 18 are gross income.

7.3.2 Community-level impacts

The short- and long-term changes in timber supply affect a growing region. The more diversified the region, the less effect changes in any one sector will have on the regional economy. For less diversified and more remote communities, any reduction to timber supply may lead to population declines and change the local economy.

Timber harvesting provides only about 7.5% of basic employment in the TSA[4]. Given that, maintaining the AAC at current levels is not expected to significantly impact on the overall economic trends of the region.

7.3.3 Nature, production capabilities and timber requirements of processing facilities

Although the long-term harvest level in the Okanagan TSA may fall below recent average annual harvest levels, local processing activity will likely only feel a minor impact. In the longer term, a constant timber supply for over 100 years will continue to support the current levels of employment, assuming that current forestry management practices continue.

7.3.4 Regional timber supply implications

Approximately 60% of the wood processed by the milling facilities in the Okanagan TSA in 1998 — 4.5 million cubic metres — is harvested from the TSA.

The future of the regional timber supply is also important to primary processors in the Okanagan TSA. In the Kamloops Forest Region, the previous Timber Supply Review led to a decrease in the conventional AAC of 0.7%, or about 50 000 cubic metres. In two to three decades the annual timber supply from the Kamloops Forest Region may fall by another 2.5%, or 175 000 cubic metres, assuming the forests are managed according to the latest Timber Supply Review.

Mill-level impacts, then, will not occur solely due to changes in the volume of timber harvested from the Okanagan TSA; they will also result from harvest changes across the region. Predicting, however, which mills and regions will be most affected, or if new, value added operations will offset or exacerbate some of these changes is impossible.

7.4 Summary

The forestry sector is an important source of employment and income for the Okanagan TSA. The TSA's processing facilities require 4.5 million cubic metres per year; about 60% of this amount comes from the Okanagan TSA. The current AAC for the Okanagan TSA is 2.615 million cubic metres. If the AAC is fully harvested and processed, it can support approximately 3,276 person-years of direct employment across the province and a further 3,978 indirect and induced jobs.

(4) Ibid.

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9 Glossary

Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Analysis unit	A grouping of types of forest - for example, by species, site productivity, silvicultural treatment, age, and or location, done to simplify analysis and generation of timber yield tables.
Base case forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic zone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Coniferous	Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Deciduous	Deciduous trees commonly have broad-leaves and usually shed their leaves annually.
Employment coefficient	The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.
Employment multiplier	An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.
Environmentally sensitive areas	Areas with significant non-timber values, fragile or unstable soils, or impediments to establishing a new tree crop, or areas where timber harvesting may cause avalanches.

9 Glossary

Forest cover objectives	Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives.
Forest inventory	An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.
Forest Practices Code	Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Free-growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Hydrologic green-up (height)	The height a stand must reach for it to provide the same timing and quantity of water yields as old-growth.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Inoperable areas	Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

9 Glossary

Integrated resource management

The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

Land and Resource Management Plan (LRMP)

A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.

Landscape-level biodiversity

The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

Landscape unit

A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Long-term harvest level

A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Management assumptions

Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

Not satisfactorily restocked (NSR) areas

An area not covered by a sufficient number of well spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

Old seral

Old seral refers to forests with appropriate old forest attributes which provide for biodiversity. Ages vary depending on biogeoclimatic variant and are specified in the *Landscape Unit Planning Guide*.

Operability

Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

9 Glossary

Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Retention VQO	Alterations are not easy to see. Up to 5% of the visible landscape can be altered by harvesting activity (see **Visual quality objective**).
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Sensitivity analysis	A process that examines how uncertainty in data and management assumptions affect timber supply.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Timber harvesting land base	Crown forest land within the timber supply area that is currently considered feasible and economical for timber harvesting.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.

9 Glossary

Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) and not harvested.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

In June of 1999 a data package for the Okanagan TSA timber supply review was released for public review. As a result of public input one management assumption has been revised (regeneration delay for all species is two years). This appendix presents the revised data package used to produce the timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Okanagan TSA timber supply analysis. This information is intended to represent current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced are not included in this appendix. The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each TSA in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

The inventory information used in this analysis combines the Ministry of Forests forest cover inventory for the Okanagan TSA (updated to 1996) with non-standard overlays added to provide information on forest conditions as well as the management considerations listed in Table A-1.

Table A-1. Major forest management considerations

Consideration/Issue	Description
Operability	Operability updated in 1997 to incorporate changes in Salmon Arm Forest District.
Community watersheds	Designated community watersheds mapped by the Ministry of Environment, Lands and Parks (MELP), Water Management Branch.
Riparian requirements	*Forest Practices Code* (FPC) requirements (stream classification not available therefore a buffer of weighted average width was applied creating a non-standard GIS overlay).
Visual quality objectives (VQO)	Areas with known VQOs (source: non-standard overlay based on line-work in *Okanagan TSA Timber Harvesting Guidelines*).
Ungulate winter range	Areas with known ungulate winter range values (source: non-standard overlay based on line-work in *Okanagan TSA Timber Harvesting Guidelines*).
Stand and landscape-level biodiversity	*Forest Practices Code* (FPC) requirements (source: draft landscape unit non-standard overlay and biogeoclimatic classification from MELP).
Lakes classification	Lakes with a classification have defined management regimes (source: non-standard GIS overlay).

Note: Data and polygon list on file at Timber Supply Branch, Ministry of Forests.

A.2 Zone and Analysis Unit Definition

In 1996 an inventory audit was performed for the Okanagan TSA. The final report presented the findings for the mature component (stand age ≥ 60 years) of the timber harvesting land base for the 1993 timber supply analysis. Audit results (50 samples) showed a difference of six cubic metres per hectare (+ 2.0%) between the mean audit volume of 299 cubic metres per hectare and mean inventory volume of 293 cubic metres per hectare. The difference of six cubic metres per hectare between these two estimates is not statistically significant, 19 times out of 20. The 95% confidence interval for the mean paired difference is –24 to +36 cubic metres per hectare. These results indicate that the volume estimates used in TSR 1 were adequate and not a notable source of uncertainty.

A.2.1 Management zones (groupings) and objectives

For the purpose of modelling current forest management, several resource emphasis groupings were defined for this analysis:

1) Landscape unit/biogeoclimatic variants;

2) Community watershed;

3) Deer winter range by ungulate winter range zone;

4) Visual quality objectives (VQO) by visually sensitive polygon;

5) Lake management plan zones.

6) Adjacency by landscape unit/biogeoclimatic variant combinations.

Land considered unavailable for timber harvesting was included in the timber supply model and contributed to the attainment of objectives for visual quality, deer management and landscape unit biodiversity.

A.2 Zone and Analysis Unit Definition

Table A-2. shows the inventory variables used to define the various model groupings used in this analysis.

Table A-2. Objectives to be tracked

Objectives	Inventory definition
Level 1 groupings — forested land base	
Old seral targets — landscape-level biodiversity	Non-standard GIS overlay of draft landscape unit (LU) boundaries and biogeoclimatic (BEC) variant boundaries as supplied by MELP. Each LU-BEC variant combination is modelled independently.
Visually sensitive polygons with visual quality objective / visual absorption capability (VQO / VAC) combinations	Non-standard GIS overlay has fields for VQO and VAC. There are four VQO values; P, R, PR, and M (preservation, retention, partial retention, modification). There are three VAC values; H, M, L (high, medium, low). There are 12 combinations. Each visually sensitive polygon is modelled independently.
Deer winter range thermal cover	Non-standard GIS overlay representing *Okanagan TSA Timber Harvesting Guidelines*.
Hydrologic green-up of community watersheds	MELP-defined community watershed (CWS), boundaries. Each CWS modelled independently.
Level 2 groupings — net timber harvesting land base	
Deer winter range block size restrictions	Non-standard GIS overlay representing *Okanagan TSA Timber Harvesting Guidelines*.
Cutblock adjacency	Modelled at the LU-BEC variant combination level.

A.2.2 Analysis unit characteristics

To facilitate modelling of stand growth and silvicultural treatments, individual forest stands were grouped according to dominant tree species (inventory type group) and timber growing capability (site index). A third grouping criteria, stand age, was also used.

Table A-3. shows the variables used to define each analysis unit. A separate timber volume was generated for each analysis unit (see Table A-18. for existing natural stands and Table A-19. for managed stands). The analysis units are not management zone specific; that is an analysis unit can be in one or more of the management zones described in Section A.2.1, "Management zones (groupings) and objectives."

A.2 Zone and Analysis Unit Definition

Table A-3. Definition of analysis units

ID	Analysis unit description	Inventory type groups	Age (years)	Criteria		
				BEC	Site index[a]	Average area-weighted site index[a]
11	Fir (Fd) / dry –selection	1-8, 32	All	PPxh, IDFxh, IDFdk1, BG	All	13.8
12	Fir (Fd) / dry – small patch	1, 6, 32	All	IDFdk2, IDFdm, MSxk	All	13.7
13	Fir (Fd) / wet	1-8, 27, 32-34	≤ 140	All BECs with exceptions of AU1 and AU2	≥ 14.5	19.0
14	Fir (Fd) / Wet	1-8, 27, 32-34	≤ 140	All BECs with exceptions of AU1 and AU2	< 14.5	13.0
15	Fir (Fd) / wet	1-8, 27, 32-34	> 140	All BECs with exceptions of AU1 and AU2	≥ 14.5	17.1
16	Fir (Fd) / Wet	1-8, 27, 32-34	> 140	All BECs with exceptions of AU1 and AU2	< 14.5	12.8
17	Cedar (Cw)	9-11	≤ 140	Entire TSA	≥ 16	19.4
18	Cedar (Cw)	9-11	≤ 140	Entire TSA	< 16	13.7
19	Cedar (Cw)	9-11	> 140	Entire TSA	≥ 16	17.4
20	Cedar (Cw)	9-11	> 140	Entire TSA	< 16	14.2
21	Hemlock (Hw)	12-17	≤ 140	Entire TSA	≥ 15	18.4
22	Hemlock (Hw)	12-17	≤ 140	Entire TSA	< 15	12.6
23	Hemlock (Hw)	12-17	> 140	Entire TSA	≥ 15	16.2
24	Hemlock (Hw)	12-17	> 140	Entire TSA	< 15	12.5
25	Balsam (B)	18-20	≤ 140	Entire TSA	≥ 13	15.5
26	Balsam (B)	18-20	≤ 140	Entire TSA	< 13	11.2
27	Balsam (B)	18-20	> 140	Entire TSA	≥ 13	14.1
28	Balsam (B)	18-20	> 140	Entire TSA	< 13	11.1
29	Spruce	21-26	≤ 140	Entire TSA	≥ 12.5	16.3
30	Spruce	21-26	≤ 140	Entire TSA	< 12.5	10.6
31	Spruce	21-26	> 140	Entire TSA	≥ 12.5	15.2
32	Spruce	21-26	> 140	Entire TSA	< 12.5	10.3
33	Lodgepole pine	28-31	≤ 140	Entire TSA	≥ 13.5	16.5
34	Lodgepole pine	28-31	≤ 140	Entire TSA	< 13.5	12.2
35	Lodgepole pine	28-31	> 140	Entire TSA	≥ 13.5	16.0
36	Lodgepole pine	28-31	> 140	Entire TSA	< 13.5	11.7

(a) Site index reference age is 50 years.

A.2 Zone and Analysis Unit Definition

The site index break points used to separate each leading tree species into two separate analysis units were based on information found in the *Forest Inventory Manual, 1994*. The site index values for medium and poor site groups were averaged to create the break point. Each analysis unit was then subdivided into two units by creating a division point at the stand age of 140 years. This allows for the old-growth site index (OGSI) sensitivity analysis where the site index is adjusted for those stands greater than 140 years of age.

A.3 Definition of the Timber Harvesting Land Base

Timber is harvested from only a portion of the total Okanagan TSA area. One of the first steps in this timber supply analysis was to define the timber harvesting land base. This land base was derived by identifying certain types of land and forest where timber harvesting is not likely to occur under current management. The characteristics of each of these types are discussed below in the order in which they were excluded from the timber harvesting base. Also shown are the types of forest where timber harvesting will not occur but that contribute to meeting other objectives such as landscape-level biodiversity.

A.3.1 Total analysis area

Only area within the Okanagan TSA boundaries, and those provincial parks within the boundaries of the three forest districts in the Okanagan TSA that contribute to non-timber management objectives are included in the timber supply analysis.

All area on the Surveyor General ownership file that is not coded as own_stat = P_C (ownership status equals provincial crown) is not included in the timber supply analysis.

Productive forest land within seventeen provincial parks was added to the total Okanagan TSA area for the analysis. While this area does not contribute to the timber harvesting land base it does contribute to meeting the objectives of other forest values. A total of 42 515 hectares was added to aid in meeting landscape-level biodiversity objectives and other objectives which are evaluated at the total forest level rather than the timber harvest land base level.

A.3.2 Current roads, trails and landings

Separate estimates are made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting, and future RTL reductions are applied after stands are harvested for the first time in the simulation model.

An inventory of roads within seven watersheds covering 89 623 hectares in the Okanagan TSA was undertaken in 1996 and 1997 by the Kamloops Forest Region research pedologist. Based on this review a reduction of 5.4% was applied to all forest stands in the timber harvesting land base less than 41 years of age, and a reduction of 0.6% was applied to those stands greater than 40 years of age. This results in an area reduction of 21 358 hectares.

The same review also recommended an area reduction of 4.9% for RTL following initial harvest of those stands greater than 40 years of age. This results in an area reduction of 41 256 hectares.

Table A-4. Estimates for existing and future roads, trails and landings

Location	Age class	Reduction per cent (%)	Reduction area (hectares)
Existing RTLs			
Roads	0 to 2	5.4	14 610
	> 2	0.6	6 747
Future RTLs			
Roads, trails and landings	> 2	4.9	41 256

A.3.3 Non-forest

Non-forest (TYPID_PR = 6) and non-typed (TYPID_PR = 8) areas do not contribute to the timber supply analysis land base. These categories include areas such as sparse alpine forest, ice, swamps, rocks and water.

A.3.4 Land not managed by the B.C. Forest Service

Productive forest in ownership codes (MoF_TYPE) 61 C and 61 N (UREP), 62 C (forest management unit), 69 C and 69 N (forest reserves) and 70 N (timber licences) contribute to the timber harvesting land base of the TSA.

Provincial parks and ecological reserves (ownership codes 67 N and 60 N) contribute to meeting biodiversity objectives. While harvesting is not permitted, these areas (46 793 hectares) remain in the total land base used for timber supply modelling.

All land that does not belong to one of the aforementioned ownership codes is not included in this analysis.

A.3.5 Non-commercial cover

Non-commercial brush types (TYPID_PR = 5), are excluded from the timber harvesting land base.

A.3.6 Inoperable areas

Operability and inoperability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting. The current operability lines were developed in 1993 and were updated in the Salmon Arm forest district only in 1997. Operability in this analysis does not consider merchantability due to the fluctuating nature of log markets.

Operability lines were derived using current forest cover information, slope classes, slope instability, avalanche concerns and swamps. Aerial photographs and local knowledge of forest district staff and forest licensees were also used. Specific details are described in the June 1999 *Okanagan TSA Timber Supply Review Data Package*.

A.3.7 Environmentally sensitive areas

Some forest lands are environmentally sensitive and/or significantly valuable for other resources. These areas are identified and delineated during a forest inventory as environmentally sensitive areas (ESAs). In the Okanagan TSA 47 403 hectares of stands with the ESA category P (regeneration problems) are excluded from the timber harvesting land base. These areas are not considered available for harvesting but do contribute to meeting forest cover requirements.

Table A-3. Description of environmentally sensitive areas

ESA category	ESA description	Reduction per cent (%)
P	Regeneration problems — high	90

A.3.8 Sites with low timber growing potential

Stands that do not currently have sufficient timber volumes to make harvesting feasible, and are not likely to achieve a harvestable volume over time (based on estimated site productivity) are excluded from the timber harvesting land base.

Table A-6. shows the minimum volume and site productivity criteria used to define stands with low timber growing potential.

Table A-6. Description of sites with low timber growing potential

Analysis unit	Inventory type group	SI limit (m @ 50 years)	Per cent (%) excluded
Dry-belt fir	1-8, 32	< 8.5	100
Wet-belt fir	1-8, 33, 34	< 8.5	100
Cedar	9-11	< 9	100
Hemlock	12-17	< 8	100
Balsam	18-20	< 8	100
Spruce	21-26	< 7.5	100
Lodgepole pine	28-31	< 7.5	100

A.3.9 Problem forest types

Problem forest types are stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability. These types are wholly excluded from the timber harvesting land base however they do contribute to meeting forest cover objectives.

Table A-7. Problem forest types.

	Criteria						
Type group or species	**Site index range (m @ 50 years)**	**Stocking class**	**Age class**	**Height class**	**Height (metres)**	**Volume /hectare (m³)**	**% area excluded**
35-42 all deciduous							100
9-34 (non-Douglas-fir)	10-13	R					100
12-17 Hemlock leading (H vol. > 70% of total volume)			8 and 9				100
1-27, 32-34 All species except Pl			≥ 6	1 and 2			100
28-31 (Pl leading)		4				< 145	100
28-31			≥ 5		≤ 18.5		100
28-31			4		≤ 12.7		100
28-31			3		≤ 9.5		100
28-31			2		≤ 5.0		100

Note that under forest health-related circumstances it may be necessary to harvest these stands in order to protect other stands which are in the timber harvesting land base.

A.3.10 Riparian reserve zones

There is currently no information available that describes the width of streams found on the FC1 or TRIM digital maps. As a result, the appropriate classification (S1-S6) cannot be assigned to each stream. However, using the results of the *Wildstone Report* completed to assess possible impacts of riparian management practices and used in the 1996 *Forest Practices Code Timber Supply Analysis*, plus additional assumptions, it is possible to analyse the available data and calculate an average streamside riparian reserve of 12.4 metres for all streams. This reserve is spatially explicit. The assumptions and calculations used to derive this value are found in Appendix A of *the Okanagan Timber Supply Area Timber Supply Review Data Package, June 1999.*

A.3 Definition of the Timber Harvesting Land Base

The *Riparian Management Area Guidebook* defines the riparian reserves and the riparian management zones widths for different classes of streams, lakes and wetlands. These specifications are also listed in the *Operational Planning Regulation*. As individual lakes and wetlands were classified using a GIS process to determine their size and the biogeoclimatic zone in which they occur, the base case data file included spatial information for each of these reserve zones.

Table A-8. Lakes and wetlands riparian management areas

Feature size and BEC	Class	Riparian Guidebook reserve width (metres)	Riparian Guidebook management zone width (metres)	Per cent (%) retention	Modelled reserve width (metres)
Lakes					
> 5 hectares	L1	10	0		10
1-5 hectares BG, PP, IDFxh, xw, xm	L2	10	20	25	15
1-5 hectares not in above BEC	L3	0	30	25	7.5
0.25-1 hectares BG, PP, IDFxh, xw, xm	L4	0	30	25	7.5
Wetlands					
Wetland complex	W5	10	40	25	20
> 5 hectares	W1	10	40	25	20
1-5 hectares BG, PP, IDFxh, xw, xm	W2	10	20	25	15
1-5 hectares	W3	0	30	25	7.5
0.25-1 hectares BG, PP, IDFxh, xw, xm	W4	0	30	25	7.5

Table A-9. Stream riparian reserve zones

Stream class	Stream length	Reserve width	Reduction per cent (%)
All	All	12.4 metres (each side)	100

To account for riparian reserve zones a non-standard GIS overlay was created to model an average riparian reserve zone on all streams and the recommended *Riparian Management Area Guidebook* riparian reserve zone for all lakes and wetlands. This resulted in a timber harvesting land base reduction of 37 677 hectares.

This reserve zone for streams is based on interior average figures for stream length by stream class, estimated in a 1994 study completed by Wildstone Resources and the riparian reserve width specifications for each stream class found in the *Riparian Management Area Guidebook*. This weighted average reserve zone, 12.4 metres applied to both sides of the stream, is then applied to all streams found on the MELP TRIM file using a GIS.

The information used in the analysis to capture the effect on timber supply from the riparian management zone is dealt with in Section A.4.5, "Riparian management zones."

A.3.11 Wildlife trees retention (WTR)

The required level of wildlife tree retention (WTR) was determined using Table A3.1 of the *Landscape Unit Planning Guide*. Review of the age class profile found in the analysis file and the area harvested without consideration for WTR indicated that 6% of the timber harvesting land base is required in WTR. The 6% target was reduced to 3% to reflect the contributions made by forest outside of the timber harvesting land base and was reduced a further 1.5% to accommodate the contributions made by those areas which have forest cover constraints on them. The resulting 1.5% target was applied as a 1.5% reduction to the volume curves of both natural and managed stands.

A volume reduction, rather than an area reduction, is used to model wildlife tree retention requirements. In the analysis it is assumed that the volume deducted to reflect WTR will not be available to harvest at a later date.

A.3.12 Timber licence reversions

Timber licences (TLs) are old tenure arrangements managed by the B.C. Forest Service that give a licensee exclusive rights to harvest Crown merchantable timber within the licence area and do not contribute to the TSA allowable annual cut. However, once these areas have been harvested and regenerated, and attain free-growing status, they revert to the Okanagan TSA and contribute to timber supply.

The forest inventory file shows a total of 17 315 hectares of timber licences in the Okanagan TSA. After accounting for land base that is removed according to the netdown process applied to all other TSA lands, approximately 14 602 hectares remain in the area considered available for harvesting in the Okanagan TSA. Of the 14 602 hectares, 9174 hectares are available to the licensee for harvest, the remainder being too young to include under the terms of the TL. It is assumed that the available area will be harvested at an even rate by the year 2030.

Table A-10. Assumed timber harvest reversion schedule

Area of timber licence (TL) harvested per decade (hectares per decade)		
1998–2008	2009–2018	2019–2030
2 867	2 867	3 440

Timber licence areas are initially assigned to groups and analysis units in the same way as the rest of the land base. When a licence area reverts it will remain in the same groups and analysis units (regenerated) that it is initially assigned to.

A.3.13 Not satisfactorily restocked (NSR) areas

Land classified in the Okanagan TSA inventory file as type identity 4 or 9 and age class projected 0 is included in the timber harvesting land base. These areas are not satisfactorily restocked (NSR); the areas remain in the land base, are re-assigned leading species if necessary and a negative age is assigned to reflect when the area is expected to become satisfactorily restocked.

A.3 Definition of the Timber Harvesting Land Base

The total area of NSR, as defined in the FIP file, within the timber harvesting land base in the Okanagan TSA is 40 459 hectares. The major licensee silviculture information system (MLSIS) and integrated silviculture information system (ISIS) records indicate 12 607 hectares of NSR. This difference was reconciled by assigning the ISIS / MLSIS identified records an age of negative 2 years while the remaining FIP identified NSR area was given an age of 2 years as the silviculture records identify these areas as no longer NSR.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

The utilization level defines the maximum allowable stump height, minimum top diameter inside bark and minimum diameter at breast height (1.3 metres) by species and is used in the analysis to calculate merchantable volume.

Table A-11. reflects utilization levels based on licence requirements and current performance.

Table A-11. Utilization levels

	Utilization		
Analysis unit	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**
Pine	12.5	30	10
Cedar	17.5	30	15
All others	17.5	30	10

A.4.2 Volume exclusions for mixed species stands

One or more species in mixed species stands may be unmerchantable. For example, the deciduous species in a predominantly coniferous stand may not be harvested, or may only be partially harvested. The non-harvested portion should not contribute to the estimated stand volume. The species that do not contribute and that were excluded from the estimation of stand volume are shown in the table below. Volume left on-site may contribute to stand-level biodiversity objectives.

Table A-12. reflects current regional utilization standards, licence requirements and current performance.

Table A-12. Volume exclusions for mixed species types

Inventory type group	Species	Volume exclusion (%)
1-34 (coniferous leading stands)	Deciduous volume component	100
1-34	Pa (whitebark pine) volume	100

A.4.3 Minimum harvestable age derivation

Minimum harvestable ages are, as the term implies, the minimum age at which harvesting is expected to be feasible. While harvesting may occur in stands at the minimum requirements in order to meet forest level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels), most stands will be harvested above minimum harvestable ages because other resource values take precedence (e.g., requirements for the retention of older forest).

Table A-13. Minimum harvestable ages

Species group	Minimum harvestable age (years)
Lodgepole pine	80
All other species	100

A.4.4 Forest cover requirements

Current forest management practices in the Okanagan TSA that were modelled using forest cover requirements and the rationale/source for the forest cover requirements are reported in the following sub-sections.

Many forest cover requirements are described as the maximum proportion of area permitted below a specified green-up height. In the timber supply analysis green-up ages are used to model the average time for a stand to reach the specified height. To derive the average green-up ages an average area-weighted site index for each analysis unit was determined. The site index and major species were used as input to the Ministry of Forests, Research Branch *Site Tools* program to calculate age to green-up height. The average area-weighted age at which green-up heights are achieved was calculated for each analysis unit. For each type of forest cover requirement (e.g., VQO retention) the average area-weighted age for the required green-up heights was calculated from the age-height data for each analysis unit.

Landscape-level biodiversity guidelines

Only the old-seral guidelines were modelled, consistent with the assumptions used in the February, 1996 *Forest Practices Code Timber Supply Analysis*. As no landscape units or biodiversity-emphasis options have yet been approved in the Okanagan TSA, an average old-seral prescription was applied to all draft landscape units. This average prescription was calculated assuming a distribution of area between biodiversity emphases of 45% lower biodiversity, 45% intermediate biodiversity and 10% higher biodiversity. The per cent area of old-seral forest to be maintained over time under each biodiversity emphasis is based on values in the *Landscape Unit Planning Guide* for each of the biogeoclimatic variants in the Okanagan TSA.

The old-seral requirements implemented include one additional consideration — the phase-in of the old-seral requirements in lower emphasis areas over three rotations (1st rotation = year 1, 2nd rotation = year 70, and 3rd = year 140). The figures found in Table A-14. show the old-seral stage requirements for each of the three periods with the final period being the full complement of old stands.

A.4 Forest Management Assumptions

Table A-14. Old seral forest cover requirements over time for BEC variants in each landscape unit

BEC variant	Minimum age	Minimum retained area (%) of old seral		
		0-70 years	71-140 years	141+ years
ESSF wc2	250	14.2	17.0	19.9
ESSFwc4	250	14.2	17.0	19.9
ESSFvc	250	14.2	17.0	19.9
ICHwk	250	9.7	11.6	13.6
ICHvk	250	9.7	11.6	13.6
ICHmw2	250	6.7	8.0	9.4
ESSFxc	140	10.5	12.6	14.7
ESSFdc1	140	10.5	12.6	14.7
ESSFdc2	140	10.5	12.6	14.7
ICHmk1	140	10.5	12.6	14.7
ICHmk2	140	10.5	12.6	14.7
ICHmw3	140	10.5	12.6	14.7
MSxk	140	10.5	12.6	14.7
MSdm1	140	10.5	12.6	14.7
MSdm2	140	10.5	12.6	14.7
IDFxh1	250	9.7	11.6	13.6
IDFxh2	250	9.7	11.6	13.6
IDFdk1	250	9.7	11.6	13.6
IDFdk2	250	9.7	11.6	13.6
IDFdm1	250	9.7	11.6	13.6
IDFmw1	250	9.7	11.6	13.6
IDFmw2	250	9.7	11.6	13.6
PPxh	250	9.7	11.6	13.6
PPdh	250	9.7	11.6	13.6

Visual quality objectives (VQO) and integrated resource management (IRM)

The visual quality objective for each area of the Okanagan TSA was determined from a visual landscape inventory non-standard GIS overlay which includes recommended visual quality class (RVQC) and visual absorption capability (VAC) information and the landscape zone as defined in the *Okanagan TSA Timber Harvesting Guidelines*. Forest cover constraints for each RVQC / VAC combination are based on criteria currently in use for the approval of proposed cutblocks.

For the analysis, forest management will be modelled with the implementation of a maximum percentage of area within each visual landscape polygon which can be below a stated visually effective green-up (VEG) height.

A.4 Forest Management Assumptions

The percentage area which can be below VEG height is a function of the RVQC and the VAC rating for each visual landscape polygon while the VEG height was determined through analysis of the slope class profile for those polygons with similar VAC ratings.

Table A-15. Visual quality objective forest cover requirements

RVQC	VAC	RVQC/VAC	Per cent denudation	VEG height (metres)	Timber harvesting land base area (hectares)
P	L	P // L	3.5	6.5	1 258
P	M	P // M	4	5.5	3 984
P	H	P // H	4.5	4.5	827
R	L	R // L	7.5	6.5	5 751
R	M	R // M	10	5.5	27 630
R	H	R // H	12.5	4.5	2 013
PR	L	PR // L	12.5	6.5	18 050
PR	M	PR // M	15	5.5	98 621
PR	H	PR // H	17.5	4.5	7 381
M	L	M // L	13.8	6.5	4 003
M	M	M // M	17.5	5.5	22 105
M	H	M // H	21.3	4.5	2 573

Ungulate winter range management

The June 1999 *Okanagan TSA Data Package* outlined the strategies from the *Okanagan Timber Harvesting Guidelines* to model ungulate winter range (UWR) management.

The forest cover requirements include a 20% maximum allowable disturbance in the net timber harvesting land base of the UWR with stands less than three metres in height and a minimum of 40% of the gross area within the forested component of the UWR being a minimum age of 75 years.

Community watersheds

Forty-seven community watersheds have been identified within the Okanagan TSA where additional forest cover requirements are the current management practice. The practice is to limit harvesting to a maximum equivalent clearcut area (ECA) of 30% of the total forested area within a community watershed. ECA refers to the area within a watershed that has been clearcut with a reduction factor to account for the hydrological recovery. Based on work completed for the 1993 Timber Supply Review, eight metres is interpreted as the tree height necessary for a stand to reach hydrological recovery. Hydrological recovery is only a concern on the snow pack portion of a watershed which in the Okanagan constitutes, on average, 60% of the watershed areas. On the remaining 40% of the watershed (non-snow pack), a green-up criteria of three metres is required before adjacent clearcut areas can be harvested. For the purpose of modelling, a weighted average of six metres [(0.6 x 8m) + (0.4 x 3 m)] will be used as the tree height that represents both adjacency and hydrological recovery on all community watersheds.

A.4 Forest Management Assumptions

The community watersheds cover a forested crown area of 267 211 hectares of which 213 349 hectares are within the timber harvesting land base.

A.4.5 Riparian management zones

Riparian management zones (RMZs) were modelled in the base case. Those areas designated as a RMZ, either for a stream, lake or wetland were removed from the timber harvesting land base. There are 38 879 hectares of riparian reserve on the analysis file. Of this area, 37 677 hectares are removed from the timber harvesting land base because they are a RMZ and the remaining 1202 hectares are removed because they meet another netdown criteria (see Section A.3.10).

Concerns were brought forward that the area reduction could be higher. The impact on the base case of practices in RMZs was assessed through sensitivity analysis.

A.4.6 Unsalvaged losses

Table A-16. shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, fires, wind damage or other agents on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume will not be recovered or salvaged. The unsalvaged losses are deducted from all harvest forecasts shown in the timber supply analysis.

Table A-16. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)
Insects	25 425
Wind	9 560
Fire	39 525
Total	74 510

A.4.7 Basic silviculture and regeneration assumptions

The silviculture program reflects the mix of treatments expected to be carried out according to the *Okanagan TSA Plan*. This level of activity assumes basic silviculture on all sites. Table A-17. shows the proportion of each analysis unit to be treated under each silviculture regime and the expected average regeneration delay.

Recent plantations and future stands will be grown on managed stand yield tables (MSYTs) produced using the B.C. Forest Service table interpolation program for stand yields (TIPSY) growth and yield model.

Table A-17. Regeneration assumptions by analysis unit

Analysis unit (initial/regen)	Leading species	Site index	Age	Regen delay	Regen species	Plant to (stems/ hectare)	OAF 1[a] (%)	OAF 2[a] (%)
11/61	Dry-belt fir (selection)	All	All	2	N/A N/A	1400		
12/62	Dry-belt fir	All	All	2	75% Fd 25% Pl	1400	15	5
13/63	Wet-belt fir	≥ 14.5	< 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	14
14/64	Wet-belt fir	< 14.5	< 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	20	20
15/65	Wet-belt fir	≥ 14.5	≥ 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	14
16/66	Wet-belt fir	< 14.5	≥ 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	20
17/67	Cedar	≥ 16	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	19	20
18/68	Cedar	< 16	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	0	20
19/69	Cedar	≥ 16	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	3	20
20/70	Cedar	< 16	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	1	20
21/71	Hemlock	≥ 15	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	13	20
22/72	Hemlock	< 15	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	–7[b]	20

(continued)

Table A-17. Regeneration assumptions by analysis unit (concluded)

Analysis unit (initial/regen)	Leading species	Site index	Age	Regen delay	Regen species	Plant to (stems/ hectare)	OAF 1[a] (%)	OAF 2[a] (%)
23/73	Hemlock	≥ 15	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	2	20
24/74	Hemlock	< 15	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	–12[b]	20
25/75	Balsam	≥ 13	< 141	2	90% Sx/Bl 10% Pl	1400	20	0
26/76	Balsam	< 13	< 141	2	90% Sx/Bl 10% Pl	1400	15	5
27/77	Balsam	≥ 13	≥ 141	2	90% Sx/Bl 10% Pl	1400	20	0
28/78	Balsam	< 13	≥ 141	2	90% Sx/Bl 10% Pl	1400	15	5
29/79	Spruce	≥ 12.5	< 141	2	90% Sx/Bl 10% Pl	1400	20	0
30/80	Spruce	< 12.5	< 141	2	90% Sx/Bl 10% Pl	1400	15	5
31/81	Spruce	≥ 12.5	≥ 141	2	90% Sx/Bl 10% Pl	1400	20	0
32/82	Spruce	< 12.5	≥ 141	2	90% Sx/Bl 10% Pl	1400	15	5
33/83	Lodgepole pine	≥ 13.5	< 141	2	90% Pl 10% Fd	1400	15	5
34/84	Lodgepole pine	< 13.5	< 141	2	90% Pl 10% Fd	1400	15	5
35/85	Lodgepole pine	≥ 13.5	≥ 141	2	90% Pl 10% Fd	1400	15	5
36/86	Lodgepole pine	< 13.5	≥ 141	2	90% Pl 10% Fd	1400	15	5

(a) OAF is operational adjustment factor. OAF 1 is a constant percentage reduction to account for small stocking gaps in stands. OAF 2 accounts for losses that increase with age, for example, due to disease. The value of OAF 2 increases from zero and passes through the shown value when the stand is 100 years old.

(b) OAF1 values for analysis units 22 and 24 are negative, meaning effectively that the OAF1 increases rather than decreases the predicted yield. OAFs were used to create yield curves that reflect regional staff expectations regarding the effects of root rots, which are prevalent in ICH stands in the Okanagan TSA. Regional staff determined that volumes in regenerated stands on these sites would be approximately 10% higher at age 100 than projected in VDYP for existing natural stands, and 10% less at age 200. Yield curves were generated using TIPSY, and adjusted by first applying an OAF2 to generate the expected curve shape, and then working backwards to determine the OAF1 that resulted in appropriate yield projections. Sometimes a negative OAF1was required. This methodology was reviewed by growth and yield staff from the Ministry of Forests, Research Branch and Kamloops Forest Region.

A.4.8 Harvest scheduling priorities

During timber supply modelling the relative oldest harvesting rule was used. Sensitivity analyses using the three other harvesting rules present in the forest service simulation model were also completed.

Table A-17. Regeneration assumptions by analysis unit

Analysis unit (initial/regen)	Leading species	Site index	Age	Regen delay	Regen species	Plant to (stems/ hectare)	OAF 1[a] (%)	OAF 2[a] (%)
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12/62	Dry-belt fir	All	All	2	75% Fd 25% Pl	1400	15	5
13/63	Wet-belt fir	≥ 14.5	< 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	14
14/64	Wet-belt fir	< 14.5	< 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	20	20
15/65	Wet-belt fir	≥ 14.5	≥ 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	14
16/66	Wet-belt fir	< 14.5	≥ 141	2	50% Fd 30% Pl 10% Sx/Bl 10% Cw/Hw	1400	33	20
17/67	Cedar	≥ 16	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	19	20
18/68	Cedar	< 16	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	0	20
19/69	Cedar	≥ 16	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	3	20
20/70	Cedar	< 16	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	1	20
21/71	Hemlock	≥ 15	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	13	20
22/72	Hemlock	< 15	< 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	–7[b]	20

(continued)

Table A-17. Regeneration assumptions by analysis unit (concluded)

Analysis unit (initial/regen)	Leading species	Site index	Age	Regen delay	Regen species	Plant to (stems/ hectare)	OAF 1[a] (%)	OAF 2[a] (%)
23/73	Hemlock	≥ 15	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	2	20
24/74	Hemlock	< 15	≥ 141	2	50% Fd 20% Sx/Bl 20% Pl 10% Cw/Hw	1400	–12[b]	20
25/75	Balsam	≥ 13	< 141	2	90% Sx/Bl 10% Pl	1400	20	0
26/76	Balsam	< 13	< 141	2	90% Sx/Bl 10% Pl	1400	15	5
27/77	Balsam	≥ 13	≥ 141	2	90% Sx/Bl 10% Pl	1400	20	0
28/78	Balsam	< 13	≥ 141	2	90% Sx/Bl 10% Pl	1400	15	5
29/79	Spruce	≥ 12.5	< 141	2	90% Sx/Bl 10% Pl	1400	20	0
30/80	Spruce	< 12.5	< 141	2	90% Sx/Bl 10% Pl	1400	15	5
31/81	Spruce	≥ 12.5	≥ 141	2	90% Sx/Bl 10% Pl	1400	20	0
32/82	Spruce	< 12.5	≥ 141	2	90% Sx/Bl 10% Pl	1400	15	5
33/83	Lodgepole pine	≥ 13.5	< 141	2	90% Pl 10% Fd	1400	15	5
34/84	Lodgepole pine	< 13.5	< 141	2	90% Pl 10% Fd	1400	15	5
35/85	Lodgepole pine	≥ 13.5	≥ 141	2	90% Pl 10% Fd	1400	15	5
36/86	Lodgepole pine	< 13.5	≥ 141	2	90% Pl 10% Fd	1400	15	5

(a) OAF is operational adjustment factor. OAF 1 is a constant percentage reduction to account for small stocking gaps in stands. OAF 2 accounts for losses that increase with age, for example, due to disease. The value of OAF 2 increases from zero and passes through the shown value when the stand is 100 years old.

(b) OAF1 values for analysis units 22 and 24 are negative, meaning effectively that the OAF1 increases rather than decreases the predicted yield. OAFs were used to create yield curves that reflect regional staff expectations regarding the effects of root rots, which are prevalent in ICH stands in the Okanagan TSA. Regional staff determined that volumes in regenerated stands on these sites would be approximately 10% higher at age 100 than projected in VDYP for existing natural stands, and 10% less at age 200. Yield curves were generated using TIPSY, and adjusted by first applying an OAF2 to generate the expected curve shape, and then working backwards to determine the OAF1 that resulted in appropriate yield projections. Sometimes a negative OAF1 was required. This methodology was reviewed by growth and yield staff from the Ministry of Forests, Research Branch and Kamloops Forest Region.

A.4.8 Harvest scheduling priorities

During timber supply modelling the relative oldest harvesting rule was used. Sensitivity analyses using the three other harvesting rules present in the forest service simulation model were also completed.

A.4 Forest Management Assumptions

A.4.9 Logging methods and silvicultural systems

Review of the 1998 development plans for the three forest districts in the Okanagan TSA showed that approximately 94% of the volume proposed for harvesting before 2003 would be completed using a clearcut harvesting method. The remaining 6% of the volume would be harvested using a selection system. Forest District staff anticipate increased usage of partial or selection harvest systems, especially in the visually sensitive and community watershed management zones.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.4a developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. Table A-18. shows the volume estimates by analysis unit for existing natural stands.

A specific volume curves was developed for the selection fir analysis unit in order to allow the model to mimic selection harvesting with approximately one third volume removal with each entry and a minimum 30 year period between entries.

A.5 Volume Estimates for Existing Stands

Table A-18. Timber volume tables for existing natural stands (cubic metres)

Analysis unit	11 selection	12 patch	13	14	15	16	17	18	19	20	21
Lead species	Fir	Fir	Fd wet	Fd wet	Fd wet	Fd wet	Cedar	Cedar	Cedar	Cedar	He
Age (years)	All	All	< 141	≥ 141	< 141	≥ 141	< 141	< 141	≥ 141	≥ 141	< 141
SI 50	All	All	≥ 14.5	< 14.5	≥ 14.5	< 14.5	≥ 16	< 16	≥ 16	< 16	≥ 15
Age (years)											
10	0	–	–	–	–	–	–	–	–	–	–
20	0	–	–	–	–	–	0	–	–	–	0
30	0	0	4	0	1	0	6	0	1	0	3
40	4	2	29	0	15	0	56	8	45	10	44
50	13	11	66	6	43	4	104	37	95	44	107
60	28	26	103	23	73	17	149	67	141	77	162
70	44	43	139	43	103	32	189	95	182	107	211
80	60	60	174	62	132	48	226	120	220	134	254
90	75	76	206	80	159	63	253	140	246	154	285
100	90	92	236	98	184	77	275	157	266	170	309
110	104	108	262	115	208	91	293	170	281	184	327
120	116	122	286	130	228	103	306	181	291	194	341
130	128	135	308	145	249	115	328	196	313	210	362
140	138	147	328	157	267	126	348	211	334	225	380
150	147	158	345	168	282	135	367	225	353	240	396
160	156	167	360	178	295	143	384	237	372	253	410
170	163	176	372	186	306	150	400	249	389	266	422
180	170	185	384	194	316	157	416	260	405	278	433
190	177	193	395	201	326	164	430	271	421	289	443
200	183	201	405	208	335	170	445	281	436	300	453
210	189	208	415	215	344	176	458	291	451	311	462
220	195	214	425	222	353	182	474	303	468	324	471
230	200	221	434	229	361	187	490	314	484	336	478
240	205	227	443	235	368	193	505	326	501	349	486
250	210	232	451	241	376	198	520	337	516	361	492
260	210	233	452	242	376	198	521	338	518	362	495
270	210	233	452	242	377	198	522	339	519	364	497
280	210	233	453	243	377	199	522	340	520	365	499
290	210	233	453	243	378	199	523	341	521	366	501
300	210	233	454	244	378	199	524	342	522	367	503

(continued)

A.5 Volume Estimates for Existing Stands

Table A-18. Timber volume tables for existing natural stands (cubic metres)

Analysis unit	22	23	24	25	26	27	28	29	30	31	32
Lead species	He	He	He	Ba	Ba	Ba	Ba	Sx	Sx	Sx	Sx
Age (years)	< 141	≥ 141	≥ 141	< 141	< 141	≥ 141	≥ 141	< 141	< 141	≥ 141	≥ 141
SI 50	< 15	≥ 15	< 15	≥ 13	< 13	≥ 13	< 13	≥ 12.5	< 12.5	≥ 12.5	< 12.5
Age (years)											
10	–	–	–	–	–	–	–	–	–	–	–
20	–	–	–	–	–	–	–	–	–	–	–
30	–	1	–	2	–	0	–	0	–	0	–
40	1	17	0	24	1	13	1	10	–	3	–
50	13	73	12	59	12	41	12	42	0	22	1
60	46	127	46	95	30	73	31	92	4	62	5
70	85	176	88	130	56	107	57	138	20	105	21
80	124	219	128	160	77	134	79	179	53	145	47
90	155	252	161	186	96	157	98	214	84	179	75
100	182	278	188	209	114	177	116	245	114	210	102
110	205	299	211	229	129	196	132	272	140	236	127
120	223	315	230	248	143	212	146	295	165	260	149
130	245	337	253	268	159	231	161	317	189	282	171
140	264	357	274	288	173	249	176	336	210	302	191
150	282	375	292	306	187	265	190	352	229	319	210
160	297	390	309	323	200	282	204	366	246	334	226
170	311	404	324	339	212	297	217	379	262	347	241
180	324	417	338	354	224	311	229	389	276	359	255
190	335	428	350	368	235	325	241	399	288	370	268
200	347	439	362	382	246	338	252	408	300	379	279
210	358	450	374	395	256	351	263	416	311	388	290
220	368	461	386	407	266	363	273	423	321	396	301
230	378	470	397	419	276	375	284	430	330	404	310
240	387	479	407	431	285	386	293	436	339	411	319
250	396	487	417	442	294	397	303	442	347	417	327
260	401	490	422	444	296	399	305	445	352	421	332
270	405	492	426	446	298	400	306	448	357	424	337
280	408	495	430	448	300	402	308	450	362	427	341
290	411	497	433	449	301	403	310	453	366	430	345
300	414	499	437	451	303	405	311	455	369	432	349

(continued)

A.5 Volume Estimates for Existing Stands

Table A-18. Timber volume tables for existing natural stands (cubic metres) (concluded)

Analysis unit	33	34	35	36
Lead species	Pl	Pl	Pl	Pl
Age (years)	< 141	< 141	≥ 141	≥ 141
SI 50	≥ 13.5	< 13.5	≥ 13.5	< 13.5
Age (years)				
10	–	–	–	–
20	0	0	0	0
30	8	0	7	0
40	46	2	42	3
50	88	28	84	23
60	125	58	122	51
70	158	86	156	77
80	188	112	185	102
90	216	136	213	125
100	242	159	238	146
110	265	180	261	166
120	288	200	283	185
130	308	219	303	202
140	323	233	317	215
150	333	244	328	226
160	341	251	336	234
170	346	257	341	240
180	348	259	344	243
190	347	259	344	244
200	349	262	346	248
210	352	264	350	251
220	355	267	353	254
230	357	270	356	257
240	360	272	358	260
250	362	275	361	263
260	364	277	363	265
270	366	279	365	267
280	368	280	367	269
290	369	282	368	271
300	371	283	370	272

A.6 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 1.4, supported by the B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index and regeneration assumptions for each analysis unit were used as inputs to TIPSY. Section A.4.7, "Basic silviculture and regeneration assumptions" and Table A-17. document which stands are assumed to be managed in the analysis.

Table A-19. displays the volume tables for managed stands. Volumes are assumed to remain constant after 250 years of age. For some tables there was insufficient growth and yield information to model to 250 years of age — data to maximum ages are presented and the maximum volume is carried forward to 250 years of age.

A.6 Volume Estimates for Regenerated Stands

Table A-19. Timber volume tables for managed stands (cubic metres)

Analysis unit	62	63	64	65	66	67	68	69	70	71	72
Lead species	Fir	Fd wet	Fd wet	Fd wet	Fd wet	Cedar	Cedar	Cedar	Cedar	He	He
Age (years)	All	< 141	≥ 141	< 141	≥ 141	< 141	< 141	≥ 141	≥ 141	< 141	< 141
SI 50	All	≥ 14.5	< 14.5	≥ 14.5	< 14.5	≥ 16	< 16	≥ 16	< 16	≥ 15	< 15
Age (years)											
10	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
30	0	7	0	3	0	6	0	2	0	5	0
40	3	36	2	19	1	38	2	21	3	42	2
50	12	82	8	50	6	94	12	68	17	106	3
60	31	131	24	88	18	154	41	124	49	169	46
70	56	171	44	128	34	202	75	171	86	221	90
80	84	205	65	159	51	243	110	225	123	269	134
90	112	235	87	185	69	277	142	262	158	307	170
100	141	259	107	209	85	303	173	293	188	338	201
110	164	281	126	229	101	325	199	318	213	361	228
120	184	299	141	245	114	342	217	336	231	378	254
130	202	313	152	259	123	354	232	352	246	391	275
140	218	323	161	270	131	362	244	365	257	401	290
150	233	332	169	280	137	367	252	372	266	407	301
160	247	339	174	287	142	370	258	377	273	409	310
170	261	339	178	294	145	374	264	380	278	407	317
180	272	339	180	298	147	374	267	380	280	404	321
190	282	339	182	299	148	374	268	377	281	401	322
200	291	339	184	301	149	374	268	373	280	394	321
210	299	339	185	302	150	374	266	368	277	389	321
220	306	339	182	303	150	374	263	363	275	389	319
230	314	339	179	304	147	374	259	358	273	389	314
240	320	339	176	304	144	374	255	350	270	389	307
250	327	339	173	303	141	374	250	341	260	389	300

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-19. Timber volume tables for managed stands (cubic metres)

Analysis unit	73	74	75	76	77	78	79	80	81	82	83
Lead species	He	He	Ba	Ba	Ba	Ba	Sx	Sx	Sx	Sx	Pl
Age (years)	≥ 141	≥ 141	< 141	< 141	≥ 141	≥ 141	< 141	< 141	≥ 141	≥ 141	< 141
SI 50	≥ 15	< 15	≥ 13	< 13	≥ 13	< 13	≥ 12.5	< 12.5	≥ 12.5	< 12.5	≥ 13.5
Age (years)											
10	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
30	1	0	0	0	0	0	1	0	0	0	20
40	18	2	4	0	2	0	7	0	4	0	65
50	69	13	35	2	16	1	49	1	29	1	116
60	129	46	91	10	55	8	112	4	83	4	156
70	183	91	157	37	109	32	180	23	146	20	196
80	230	137	213	76	167	68	238	56	202	50	235
90	272	175	267	119	215	110	297	95	254	88	261
100	305	207	321	163	262	154	347	137	308	128	288
110	332	236	362	199	311	190	385	174	351	166	310
120	355	262	393	235	349	225	414	208	384	199	328
130	371	285	418	270	379	259	436	240	410	231	342
140	382	300	438	305	403	294	455	274	431	263	355
150	390	312	456	331	422	322	471	305	449	295	366
160	396	321	470	355	439	346	486	329	463	321	375
170	398	328	483	371	453	365	497	351	477	343	383
180	399	333	494	386	466	379	507	367	488	360	390
190	397	334	503	398	477	393	516	381	497	374	396
200	393	333	512	408	487	402	518	392	506	387	402
210	387	333	516	417	495	411	520	401	514	396	406
220	381	331	517	424	502	420	521	410	516	405	410
230	373	326	519	430	509	426	523	417	517	412	411
240	363	320	521	436	513	431	524	423	519	418	413
250	352	312	522	441	515	436	526	428	520	423	414

(continued)

Table A-19. Timber volume tables for managed stands (cubic metres) (concluded)

Analysis unit	84	85	86
Lead species	Pl	Pl	Pl
Age (years)	< 141	≥ 141	≥ 141
SI 50	< 13.5	≥ 13.5	< 13.5
Age (years)			
10	0	0	0
20	0	0	0
30	1	16	0
40	14	56	9
50	39	108	32
60	67	146	56
70	99	182	88
80	122	221	112
90	143	251	131
100	161	275	149
110	179	296	165
120	199	314	182
130	216	329	199
140	230	341	214
150	241	352	227
160	250	362	236
170	259	370	245
180	267	377	252
190	273	382	259
200	279	388	265
210	284	392	270
220	289	397	275
230	293	400	279
240	298	404	282
250	301	404	286

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The report identifies employment and income impacts, changes in government revenues, and community impacts at various harvest levels and times in the future. This type of analysis requires several assumptions of which the reader should be aware. Some of these assumptions are outlined below:

- **Employment multipliers** — the multipliers used in the analysis of indirect and induced impacts are based on analytical assumptions and estimated using data collected at a certain time, thus they reflect industry and employment conditions at that time. Consequently, they may not accurately reflect future industry conditions. While generally sound indicators when based on fairly recent information, older multipliers may not reflect the industry under examination. In any impact analysis, the information should be considered as an order of magnitude indicator.
- **Employment coefficients** — employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres). This approach assumes that the industry structure will be the same in future as it is today. While reasonably accurate in the short term, employment coefficients may change due to changing market conditions or production technologies, for example.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting sub-sector, this may not be the case for the processing and silviculture sub-sectors of the forest industry. Additionally, indirect and induced impacts will likely occur over a longer period of time, as business and consumer spending levels adjust.
- **Processing thresholds** — impacts on processing jobs are unlikely to occur in direct proportion to harvest changes (i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction). Impacts related to processing thresholds are more likely to occur step-wise. A processing threshold is the level of a mill's timber supply where, when reached, will cause a mill to either lay off a shift or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is not possible. As a result, the analysis may overestimate processing impacts if mills continue to operate the same number of shifts, but perhaps at lower production levels. Alternatively, the analysis could underestimate impacts if a mill were to eliminate a shift. Over the medium- to long-term the impact figures should be reasonably accurate, however.
- **Government expenditures** — provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care, and other government services are assumed to not change despite harvest changes and any subsequent change in government revenues. However, public expenditures would likely change if community population levels change sufficiently. This change would amplify the community impacts of forestry job losses or gains.
- **Proportional harvest reductions** — harvest reductions are assumed to be spread evenly among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators, and processing facilities in the TSA. Other general economic data are from BC STATS, the B.C. Ministry of Finance and Corporate Relations, Statistics Canada, and local communities.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is a full-time job that lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1) harvesting;

2) silviculture; and,

3) timber processing.

The procedure for estimating employment and income impacts involves several steps. First, current activity in each of the three sub-sectors was assessed. Then, indirect and induced employment and employment income impacts were estimated using data from the B.C. Ministry of Finance and Corporate Relations and Statistics Canada. Next, employment coefficients were calculated and applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes, were also calculated using B.C. Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log transport, log salvage, planning, and administration functions. While road building and maintenance work are important activities in the forest industry, the employment multipliers used in this analysis define these activities as indirect rather than direct. Therefore, road building and maintenance employment are not included in the direct impact estimates, but are captured in the estimates of indirect impacts. Including these as direct would double-count and overestimate employment impacts.

Data on employment, place of residence, and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1) TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and,

2) Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning, and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who lived within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production, and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber requirement was supplied by the harvest from the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was similarly estimated.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employment in the forestry sector refers to those who provide goods and services to firms directly engaged in the basic forestry sector (for example, those who provide road maintenance services). Induced employment refers to those who provide the goods and services purchased by employees who are directly and indirectly engaged in the industry (for example, those who work in retail outlets). Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by the B.C. Ministry of Finance and Corporate Relations.

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that a displaced worker remains in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

The TSA and provincial employment multipliers used in the Okanagan TSA analysis are shown in Table B-1.

Table B-1. Total employment multipliers

Forest sub-sector	TSA migration multiplier	TSA no-migration multiplier	Provincial interior migration multiplier	Provincial interior no-migration multiplier
Harvesting	1.57	1.36	2.14	1.80
Solid wood processing	1.56	1.34	2.29	1.93
Pulp	N/A	N/A	3.02	2.48

Sources: Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector. B.C. Ministry of Finance and Corporate Relations, Victoria, B.C.

B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables.

N/A: not applicable.

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices, and forest management assumptions and will not likely reflect industry operating conditions far into the future. Therefore, the employment estimates should be viewed as indicators of the general size of change rather than as precise estimates of changes in employment levels.

Employment income estimates

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada Survey of Employment Payroll and Hours. In 1998, the average annual income for direct forest sector employees was approximately $45,500, and $34,000 for indirect and induced employment (in 1997 dollars). These figures are based on a selection of business and personal service sectors, accommodation, food and beverage sector, and the construction sector average annual wages. Income taxes were calculated based on marginal tax rates of 23-28% with one-third of the total income tax accruing to the province.

Provincial government revenues

Except for stumpage, royalty, and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated. See Table B-2.

Table B-2. Okanagan TSA provincial government revenue estimates

	Average revenue 1996–1999 ($1997 millions)	Revenue ($/'000s m^3)
Stumpage, rents, and royalties	66.5	22,868
Industry taxes	21.6	7,427
Provincial income tax	26.8	9,215
Total government revenues	115.0	39,510

Source: B.C. Ministry of Forests. Price Waterhouse.